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Soil Survey

of

Broome County, New York

By

CLARENCE LOUNSBURY, in Charge, and A. H. HASTY
United States Department of Agriculture

and

D. F. KINSMAN and J. H. BARAN
Cornell University Agricultural Experiment Station

Bureau of Chemistry and Soils

In cooperation with the Cornell University Agricultural Experiment Station

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SOIL SURVEY

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By CLARENCE LOUNSBURY, in Charge, and A. H. HASTY, United States Department of Agriculture, and D. F. KINSMAN and J. H. BARAN, Cornell University Agricultural Experiment Station

INTRODUCTION

Broome County, situated in the plateau section of southern New York, is fairly well dissected by natural drainageways. All the drainage is toward the south, and most of it is carried by Susquehanna River and its tributaries. A small section of the eastern part of the county drains into Delaware River. The elevation of the main ridges ranges from 1,500 to 1,600 feet above sea level and of the main valleys from 800 to almost 1,000 feet.

The climate is favorable to the prevailing dairy type of agriculture and to the raising of subsistence crops. The rainfall is well distributed, and the temperatures are moderate, with rather short warm summers and cold winters.

The configuration of the county, although dissected, includes well-rounded valley slopes and rather narrow ridge tops, the result of the action of glaciers which in past ages covered this section and moved the existing soil material. A large part of this material was composed of the underlying fine-grained gray sandstone and shale rocks, but some of the valley-fill materials, which contain limestone, were brought in from distant limestone beds to the north. Most of the soils are derived from siliceous materials and are acid in reaction.

The land was originally forested, and this condition, under the heavy rainfall, favored development of soils included in the Gray-Brown Podzolic belt which prevails in northeastern United States. The soils over a large part of the uplands are more or less deficient in drainage, although in many of the higher lying situations the Lordstown soils, which are rather shallow over bedrock, and the Wooster soils, which are much deeper and occur at somewhat lower elevations, are well drained. Along most of the slopes, where the soils have been subject to seepage from higher levels, conditions have favored the development of a hardpan in the subsoils. Where the surface-soil materials are well drained to a depth ranging from 16 to 20 inches over the hardpan, the soils have been classed as Canfield and Langford soils, the Canfield soils having acid subsoils and the Langford soils having an alkaline reaction. In less well drained places, where the surface soils are darker and the hardpan is nearer the surface, the Volusia soils have developed, and in associated locations which are too poorly drained to be arable, the Chippewa soils occur.

The valley floors have received deposits underlain by gravels or porous materials; consequently they have good drainage in most places. The soils lying above stream overflow and having an acid reaction are classed as Chenango soils, and similar associated soils having an alkaline reaction, owing to their limestone content, are recognized as Howard soils.

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The better drained soils in the first bottoms have been classed as Tioga where of acid reaction and as Chagrin where alkaline. Less well drained soils of the first bottoms have been classed as Middlebury, Holly, and meadow.

In the southeastern part of the county, where brown sandstone and red shale rocks prevail, the soils are more or less red. The Lackawanna soils, which have a pronounced red color, occupy high positions, and the Walton soils, which are similarly red, occupy valley-fill positions. The Walton soils have hardpan subsoils, as do the Culvers soils which are associated with them but have a browner color.

Steep phases of most of the upland soils are recognized and indicate areas too steep for profitable cultivation, both as regards preparation of the land and obtaining a satisfactory crop return. The clean-cultivated areas of the steep phases are subject to destructive erosion. The soils in such areas are light in color, generally acid, and not well adapted to crop production, but they produce fair hay and furnish good pasture to support dairying which dominates the agriculture of the county. Dairy products find ready sale in New York City and its suburbs.

The principal crops are corn for silage, oats, hay (consisting of timothy, clover, and some alfalfa), and other forage crops. Poultry raising is on the increase, both separately and in connection with dairying. Some truck growing is carried on near Binghamton.

COUNTY SURVEYED

Broome County is in the south-central part of New York, with the Pennsylvania-New York State line forming its southern boundary (fig. 1). It is L-shaped. The maximum distance from north to south is 29 miles and from west to east is 32 miles, and the total area is 705 square miles, or 451,200 acres. The distance from Binghamton to New York by the Erie Railroad is about 215 miles and to Buffalo is 210 miles.

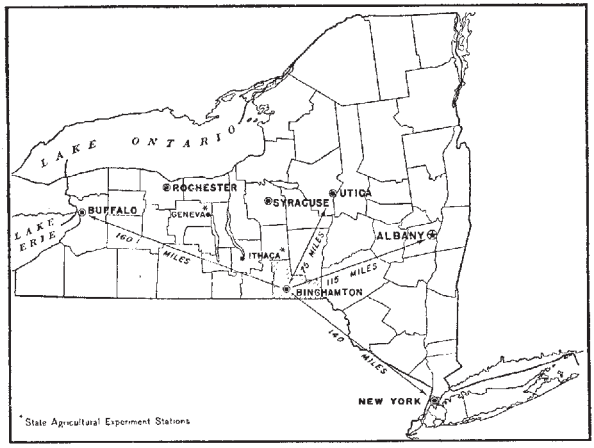


FIGURE 1.—Sketch map showing location of Broome County, N. Y.

This county comprises a part of the plateau section of southern New York and northern Pennsylvania (pl. 1, *A*). The part of the plateau included in Broome County consists, in general, of a considerably dissected plain rising gradually to the south and east, where it begins to grade into the Catskill Mountain section.

Nearly all the drainage is controlled by Susquehanna River and its tributaries, and that of a small area in the eastern part flows to Delaware River. Both drainage sections have distinct physiographic features. The Susquehanna section includes two main or dominant nearly parallel valleys which control the southward-flowing drainage, that of the Susquehanna and its principal tributary in this county, Chenango River. Susquehanna River enters from the north near the northeastern corner and flows almost due south across the county into Pennsylvania, where it turns northward and reenters the county near the middle of the southern boundary. About 10 miles north of the boundary it turns westward and leaves the county near the southwestern corner. The entire area is well dissected and is characterized, for the most part, by rather narrow dividing ridges with well-rounded tops and fairly broad slopes descending to the valley bottoms. The smaller drainage valleys leading into the main valleys have a southerly trend and, together with their tributaries, have developed a dendritic pattern. Drainage is sufficiently complete that there are no important areas in which the run-off is very sluggish. The valley floors of the larger stream valleys range from one-half mile to nearly 2 miles in width, are comparatively smooth, but present some unevenness, owing to the presence of terrace deposits and bench formations. In the eastern part of the county the configuration is more sharp, the valley slopes, especially along the Susquehanna River Valley, are more abrupt and narrow, the valleys are more gorgelike, the valley floors are narrow, and the terrace formations are small.

Most of the county lies at an elevation of less than 2,000 feet above sea level, as determined by the United States Geological Survey. In the uplands of the northern part, the elevation ranges from 1,400 to 1,600 feet, and along the southern border from about 1,750 to more than 1,900 feet. In several places along the eastern border the elevation is more than 2,000 feet. At the point where Susquehanna River enters the county at Nineveh, the elevation is 960 feet; at the junction with Chenango River at Binghamton, 845 feet; and at the point where it leaves the county on the western border, 800 feet. The elevation at Deposit on Delaware River is nearly 1,000 feet.

Broome County originally was covered by a mixed forest, in which white pine was prominent and hemlock common. The principal hardwoods were white oak, red oak, black oak, hard maple, beech, ash, elm, ironwood, and several other species. Practically all the original white pine and most of the deciduous hardwoods were removed as the country was settled. One small tract of virgin white pine still remains about 1 mile west of Ouaquaga. The present forest consists largely of various second-growth hardwoods and some hemlock on some of the steeper slopes having shallow seepy soils (pl. 2, *A*). The undergrowth, which is not abundant, is mainly witch-hazel, striped maple, and bracken fern. Ferns are more common in the eastern part of the county, also *Spiraea* (hardhack) and mountain-laurel.

Permanent settlement of the land now included in this county[1] began in 1787 on the present site of Binghamton, and the population

[1] SMITH, H. P., ed. HISTORY OF BROOME COUNTY, WITH ILLUSTRATIONS AND BIOGRAPHICAL SKETCHES OF SOME OF ITS PROMINENT MEN AND PIONEERS, 630 pp., illus. Syracuse, N. Y. 1845.

has increased gradually and steadily. Broome County was formed from a part of Tioga County March 28, 1806, and was named in honor of John Broome, then Lieutenant Governor of the State.

The rural population is largely of English extraction. The early settlers came from the New England States, eastern New York, New Jersey, and Pennsylvania. In the industrial towns of Binghamton, Johnson City, and Endicott, there are many Poles, Slovaks, Italians, and other Europeans. The total population of the county in 1930 was 147,022, of which 40,562 were classed as rural. Binghamton, with a population of 76,662, is the county seat. Johnson City, adjoining Binghamton, has a population of 13,567, and Endicott, a few miles farther west, has 16,231. Port Dickinson, Vestal, Kirkwood, Windsor, Deposit (partly in Delaware County), Harpursville, Chenango Forks, Maine, Whitney Point, Lisle, and Killawog are small towns and villages.

Two trunk-line railroads between New York and Buffalo, the Erie and the Delaware, Lackawanna & Western, pass through the county, and branches of the Lackawanna lead northward to Syracuse and Utica. A branch of the Delaware & Hudson Railroad extends from Binghamton to Albany. The Liberty Highway passes through the county, and other concrete and hard-surfaced roads lead through many parts. Improved surfaced roads are gradually being extended. Dirt roads are kept well graded and in dry seasons are in good condition. Bus and airplane services are available.

Rural delivery of mail covers most sections, but somewhat less than half the farms have telephones. School and church facilities are adequate, and in some localities pupils from rural districts are transported to centralized village schools. About one-third of the farms are supplied with electricity for light and power.

Considerable manufacturing is carried on in the "Triple Cities"—Binghamton, Johnson City, and Endicott. Large shoe factories operate in Johnson City and Endicott and smaller ones in Binghamton. Other manufacturing plants produce cameras and films, time clocks, scales, motor trucks, proprietary medicines, toilet articles, chemicals, baked goods, cigars, machines and accessories, furniture, washing machines, leather goods, and wearing apparel. Binghamton is an important wholesale distributing center for a variety of products. The industries of the triple cities maintain pay rolls for more than 25,000 workers.[2]

CLIMATE

Climatic conditions in Broome County compare favorably with those of other localities in southern New York where the climate is continental. The range between the mean temperatures of summer and winter is rather wide—42.5° F. The summers are mild and of moderate length, with brief periods of extreme heat. The winters are cold, and heavy snowfalls occur at times. The severe part of winter is from December to March, inclusive, and snow and low temperatures may be expected during this period. In spite of occasional mild periods, preparation of the land for crops rarely can be accomplished during the winter. Some snow has been reported as early as November and as late as May. Climatic conditions in vari-

[2] Information obtained from the Binghamton Chamber of Commerce.

ous parts of the county do not differ greatly, although snow remains longer on the hills than it does in the valleys which may lie 1,000 feet or more lower. In many years land in the valleys can be worked from 10 to 15 days earlier in the spring than can land at the higher elevations. Cultivation of the hill land is delayed not only by its elevation but by dense subsoils which occur in many places and require a longer time to dry after the winter freezing than do the more freely drained subsoils of the valley land.

As recorded at the Weather Bureau station at Binghamton, the average frost-free period is 158 days, the average dates of the latest and earliest killing frosts being May 3 and October 8. Killing frosts have been recorded as late as May 29 and as early as September 14. Variations in certain locations and at certain elevations are caused by so-called air pockets in some of the valleys, which favor frosts, whereas at a different location or elevation no frost occurs.

Table 1 gives the more important climatic data for Broome County as recorded by the United States Weather Bureau station at Binghamton.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Binghamton, Broome County, N. Y.*

[Elevation, 871 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1900)	Total amount for the wettest year (1927)	Snow, average depth
	° *F.*	° *F.*	° *F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	28.2	68	−22	2.31	1.40	3.64	10.4
January	24.1	70	−28	2.45	1.59	2.05	11.7
February	24.0	65	−21	2.27	2.65	3.34	11.6
Winter	25.4	70	−28	7.03	5.64	9.03	33.7
March	32.6	80	−11	2.62	3.17	2.21	10.0
April	45.4	88	15	2.48	1.35	3.10	2.3
May	57.4	94	23	3.31	.53	5.60	0
Spring	45.1	94	−11	8.41	5.05	10.91	12.3
June	65.6	98	31	3.39	1.54	2.58	0
July	70.0	98	40	3.70	2.29	3.38	0
August	68.1	99	35	3.59	.67	3.20	0
Summer	67.9	99	31	10.68	4.50	9.16	0
September	61.3	97	27	3.09	2.10	2.29	0
October	50.0	92	17	2.97	2.05	7.98	.1
November	38.7	76	5	2.40	3.08	4.72	5.1
Fall	50.0	97	5	8.46	7.23	14.99	5.2
Year	47.1	99	−28	34.58	22.42	44.09	51.2

Rainfall is well distributed throughout the year. Occasionally the precipitation may be excessive or deficient, but neither condition is sufficient to cause crop failure. Ordinarily the heaviest rainfall occurs during the summer and the least during the winter. The average annual snowfall of 51.2 inches is usually sufficiently continuous to protect grass and fall-seeded crops from freezing and injury by heaving.

The prevailing winds blow from the west and northwest and are more frequent during late winter and early spring. Tornadoes or

destructive winds are infrequent. Hailstorms cause some damage locally.

More cloudy weather occurs in winter than in summer, and probably from 70 to 75 percent of the summer days are sunshiny.

AGRICULTURE

At the time of settlement of Broome County the heavily forested land required clearing, in order to allow crop production. Lumbering was an important industry for many years, and so long as the comparatively easy profits from lumbering continued, agricultural development was slow. As lumbering, however, declined, the importance of farming increased. The opening of the Chenango Canal in 1837, affording easy transportation to and from the county, greatly stimulated agricultural development, as did the extension of the Erie Railroad in 1849 and of other railroads soon after.

The early agriculture was primarily on a subsistence and self-sustaining basis, with some surplus products for market, and was conducted with little regard to the adaptability of crops. When the western prairie States were settled, the production of corn as well as wheat on eastern farms became less profitable, in competition with these newly developed lands, owing to their productivity and smooth relief which facilitated the use of farm machines. As a result, the production of corn and wheat (as cash crops) declined and the raising of livestock, with a gradual trend to dairying, assumed importance. Dairying has greatly increased in recent years and now dominates agriculture.

Tobacco was of some importance as a crop in the decades between 1860 and 1900. Tobacco production appears to have reached its peak in 1889, in which year 84,100 pounds were produced.

The growing of sugar beets was a short-lived industry which resulted in the operation of a beet-sugar factory near Binghamton from 1898 to 1903, with a capacity of 500 tons a day. Although beets of good quality were grown on many of the river-valley soils, not enough were produced to maintain the factory on a profitable basis.

Table 2 gives the acreage devoted to the leading field crops in 1879, 1889, 1899, 1909, 1919, and 1929, as reported by the Federal census.

TABLE 2.—*Acreage of principal crops in Broome County, N. Y., in stated years*

Crop	1879	1889	1899	1909	1919	1929
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Corn	9,673	3,938	4,895	2,742	1,857	[1]398
Oats	22,485	21,941	20,341	12,950	13,423	7,300
Wheat	6,116	1,326	962	211	792	235
Rye	993	1,135	1,427	745	434	111
Buckwheat	8,804	7,259	6,102	7,894	5,374	3,942
Potatoes	5,086	6,204	7,248	7,106	5,005	2,971
Hay	92,963	106,638	97,965	103,296	103,123	81,246

[1] Harvested for grain. In addition, corn from 5,015 acres was cut for silage, from 1,021 acres was cut for fodder, and from 58 acres was hogged off.

The gradual decline in acreage of grain crops, which has accompanied the development of dairying in recent years, may be

noted in table 2. These crops, which to some extent were cash crops, have now become subsistence crops. Buckwheat is primarily a cash crop. Potatoes are produced, chiefly for home use, and there is usually some surplus for market. A few farmers in the northern part of the county grow potatoes as a special crop. Hay includes timothy, clover, alfalfa, other tame grasses, wild grasses, and grains cut green. The acreage in alfalfa, although this is a comparatively unimportant crop, has increased within the last three decades from experimental fields to a creditable acreage.

Where dairying is an important agricultural activity, as in Broome County, pasture is important. In 1934, according to the Federal census, this county had a total area of 162,496 acres in pasture, of which 49,098 acres were classed as plowable pasture, 35,208 acres as woodland pasture, and 78,190 acres as other pasture. The plowable pasture may be considered improved land, which supports a fair amount of bentgrass and bluegrass and some poverty grass, depending on the kind of soil and the condition and care of the pasture. The better soils, such as the Chagrin and Tioga, support the more vigorous sod, dominantly of bluegrass. On the upland such soils as Langford usually support the best grass cover, and the pastures contain a larger proportion of bluegress and bentgrass than of poverty grass. On other soils, particularly the Walton, Wooster, and Lackawanna, the pastures may contain more bentgrass than poverty grass, but on such soils as the Canfield, Lordstown, and Culvers, poverty grass usually dominates, unless the pasture has been seeded recently or rejuvenated by amendments. The soils developed on the terraces support a less vigorous grass cover unless improved, but little of these soils is used for permanent pasture.

In the older pastures many different weeds, ferns, and *Spiraea* (hardhack) are found. Hawthorn, however, is the leading pasture pest of this section and usually precedes forest sprouts, the end of all neglected pastures.

The chief cash income on farms is derived from the sale of dairy products which have increased in value from $995,967 in 1899 to $3,980,420 in 1929. The poultry industry also has increased in importance. In 1899 the poultry raised had a value of $87,800, and in 1929 a value of $389,804.

Tables 3 and 4, respectively, give the values of different farm products by classes in 1929, and the number and value of animals on farms April 1, 1930.

TABLE 3.—*Value of agricultural products, by classes, in Broome County, N. Y., in 1929*

Crop	Value	Livestock and products	Value
Cereals	$206,621	Domestic animals	$3,980,420
Other grains and seeds	16,601	Dairy products, excluding home use	3,368,191
Hay and forage	1,326,228	Poultry and eggs	961,732
Vegetables	510,053	Wool	5,339
Fruits and nuts	93,416		
All other field crops	9,236	Total	8,315,682
Total	2,162,155	Total agricultural products	10,477,837

TABLE 4.—*Number and value of domestic animals, chickens, and bees on the farms of Broome County, N. Y., Apr. 1, 1930*

Animals	Number	Value	Animals	Number	Value
Horses	5,044	$596,246	Goats	140	$945
Mules	148	17,382	Swine	2,864	44,060
Asses and burros	3	210	Chickens	198,396	228,155
Cattle	44,635	3,284,759	Bees (hives)	2,636	15,025
Sheep	3,835	36,818			

Most of the fruit is grown for home needs, although a few commercial apple orchards are meeting with some success. The favorite varieties of apples are Baldwin, Northern Spy, and Rhode Island Greening. The 1930 census reports a total of 70,742 apple trees in 1929 and smaller numbers of peach, pear, plum, and cherry trees, and grapevines. Strawberries, raspberries, blackberries, and dewberries are grown to some extent.

Near Binghamton a few farmers specialize in truck farming, and in more scattered locations others are growing some special crops. Truck crops, which include cabbage, sweet corn, carrots, parsnips, cucumbers, tomatoes, spinach, beets, snap beans, asparagus, onions, squash, green peas, celery, and lettuce, generally have a ready sale in the manufacturing towns of Binghamton, Johnson City, and Endicott.

Corn is produced largely for silage. Sweepstakes is a widely grown variety, and Lancaster Surecropper produces well on good soil. Some flint corn is grown, principally the King Philip variety. Many varieties of oats are grown, but Cornellian is favored by many farmers. Buckwheat is largely of the Silverhull and Indian varieties. Most of the small acreage of wheat is devoted to spring varieties. Barley, usually grown with oats, is mainly of the Alpha variety. Potato varieties include Green Mountain, Rural New Yorker, Prolific, and Irish Cobbler. Japanese millet is grown, both as green feed and for the seed. To some extent soybeans and Sudan grass are grown after planting corn, and both are regarded as good green feed.

For maintaining soil fertility, reliance is placed first on stable manure, the use of which is generally efficient. Commercial fertilizer, to a large extent, consists of superphosphate which may be mixed with animal manure for the staple crops. It is applied separately to some extent. Some ready-mixed fertilizers, such as 4–12–4 or 5–10–5,[3] are used by many truck growers. According to the 1930 census, 1,591 farms reported a total expenditure of $109,130 for fertilizers in 1929.

Nearly all the concentrated feeds used in the production of milk are purchased. The 1930 census reports 2,616 farms making a total expenditure of $1,728,916 for feed in 1929. Most of the roughage feeds, such as silage, other green feeds, and hay, are produced on the farm where used.

Farm labor usually is adequate to supply the needs. During the recent industrial depression a minimum of labor has been employed, and so far as possible the farms are operated by the farmer and his

[3] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

family. The 1930 census reports an expenditure of $523,614 for labor on 1,543 farms in 1929, or an average of $339.34 a farm reporting. Until recently monthly wages have ranged from $30 to $50 including board. Day labor is employed more often during busy seasons and in handling truck and special crops, and the wages for such labor range from $2 to $3. Married men are usually furnished a house, fuel, milk, garden plot, and other facilities in addition to their regular monthly wages.

As most of the dairy farmers utilize much of the available rugged land, farms in the rougher parts of the county are somewhat larger than those in the smoother parts. With the increase in dairying during recent years the size of farms has increased. Since 1880 the average size of farms has gradually increased from 89 acres to 108.3 acres. Most of the dairy farms range from 75 to 250 acres in size. On the average farm 54.4 percent is improved crop land and plowable pasture, and the rest is woodland pasture, other pasture, woodland not in pasture, and other farm land.

The 1930 census reports 88.7 percent of the farms operated by owners, 10.3 percent by tenants, and 1 percent by managers, showing an increase since 1900 in owner-operated farms from 75.6 percent of the total number. Rentals are mainly on a half-share basis, the details varying with the farm improvements, kinds and numbers of livestock kept, and other factors.

Most of the farm buildings are substantially built, well maintained, and suited to the type of farming engaged in. The barns generally provide ample space for housing cattle and other livestock, in addition to storage space for hay and other feed. Silos form a part of the equipment on the better dairy farms. Power milkers and improved farm water-supply systems are in general use. Farm machinery in general is of the better types, including tractors with the adapted plowing and pulverizing equipment, hay and other harvesting machines, and motor trucks.

Very little farm land has changed ownership in the last few years, although many well-located and improved farms may be purchased at reasonable prices. Some of the land in the remoter sections has been abandoned for farming, and some of this land has been sold recently at a nominal figure to the State for forestry purposes. In 1930 the average assessed value of farm land, including buildings, was $58.68 an acre.

Attention naturally centers on dairying, the leading farm activity. The aim at all times is to maintain healthy herds of cattle of good productive capacity, to furnish a satisfactory volume of milk. For this purpose the Holstein-Friesians lead, with a few herds of Guernseys, Ayrshires, and Jerseys. With some exceptions the dairy cattle are good grades, and practically all sires are purebred. Progress has been made in eradicating tuberculosis in cattle, and at the time of this survey (1932) all except two townships were pronounced free from this disease. The 1930 census reports 25,157 cows milked in 1929.

Practically all the milk is marketed as whole milk. In 1929, 16,050,598 gallons of milk were produced,[4] of which 14,107,229 gal-

[4] NEW YORK DEPARTMENT OF AGRICULTURE AND MARKETS. STATISTICS RELATIVE TO THE DAIRY INDUSTRY IN NEW YORK STATE 1931–1932. N. Y. State Dept. Agr. and Markets Bull. 267, 190 pp., illus. 1932.

lons were sold as whole milk, and the rest was handled principally as butter and cream either for home use or sale. Some farms and milk companies supply individual customers of the Triple Cities, but most of the milk is shipped to the larger metropolitan markets.

Farm animals other than cattle are comparatively unimportant. A few sheep are raised, mostly grade Hampshires and Shropshires. Sheep raising probably is declining largely on account of ravages of dogs, in spite of a night quarantine on these animals. Scarcely any swine are raised in a commercial way, but many farmers keep a few hogs for a home supply of meat. A few farmers near Binghamton, who can obtain suitable garbage from the city, raise larger numbers of hogs. Chester White and Duroc-Jerseys are among the favored breeds.

Practically all farmers keep some poultry, and some dairy farmers have gone extensively into poultry raising which centers chiefly in the vicinities of Willow Point and Kirkwood. The White Leghorn breed is favored, and some Rhode Island Reds and Barred Plymouth Rocks are raised.

Some farmers raise turkeys, geese, and ducks.

The general cropping scheme consists of growing corn (largely for silage), oats, and hay, including timothy, clover, and some alfalfa and millet. The common practice is to plant corn on plowed sod land and follow it with oats the next year. Seeding with timothy and clover accompanies or immediately follows the oat seeding.

Land for corn is plowed in the fall, if time be available, or as early in the spring as the season allows. Fall-plowed land benefits from winter freezing and thawing, which results in a more even bedding of the soil than where it is spring plowed. This practice allows more thorough incorporation of organic matter and aids in the destruction of hibernating insect pests. Land for oats is fall plowed when possible. Spring preparation of plowed land consists of thorough harrowing and, on many farms, of disking. Oats are sown in early May or late April, if possible, and corn planting follows later in May. Late potatoes are planted about the same time as corn. Planting of crops is ordinarily somewhat earlier in the valleys, where the snow melts earlier in the spring and where many of the soils have free subsoil drainage, than is possible on the uplands which hold snow longer and where the dense subsoils of most soils do not allow excess moisture to escape so readily.

Oats usually mature by August 15, following the haying season. Silage corn is harvested and stored, if possible, just before killing frosts may be expected, generally about the middle of September.

The use of lime is recognized as important in maintaining soil productivity, especially in insuring success with clovers and other legumes. On most of the naturally acid soils, from 1,500 pounds to 3 tons of lime an acre are applied once in a crop rotation. Ground limestone is used chiefly, but many farmers prefer hydrated lime. The larger quantities of lime give better results when divided through the rotation, that is, about 1 ton an acre with the corn crop and another with oats in connection with the grass seeding. All available stable manure is used, and a large part is applied to sod land before plowing. Some farmers reserve a supply in compost heaps to be used as a top dressing on grass and other crops. Com-

mercial fertilizers are used in the forms of complete fertilizer or superphosphate alone. Some farmers report that they obtain as satisfactory results with superphosphate as with complete fertilizers, especially if ample quantities of stable manure have been used.

The soils of the county are not naturally well supplied with organic matter, and, on many farms, land once moderately productive has become unprofitable, owing to neglect in fertilizing and cropping practices. Under consistent crop and fertilizer management, the fertility of such soils as the Canfield and Volusia can be maintained and improved.

SOILS AND CROPS[5]

The soils of Broome County have developed under forest conditions which have prevailed many hundreds of years, and they are therefore comparatively light colored. The forest debris, consisting of leaves and woody matter, on decaying has produced some organic matter, but, with the continued active leaching, no great quantities of organic matter or humus have accumulated as in prairie regions where a grass cover has existed over a long period of time. Lighter colors prevail in places where oxidation has been more complete and darker colors where the soils are less well oxidized, owing to deficient drainage.

The soils of the greater part of the county, probably 90 percent, are composed of mineral constituents derived largely from fine-grained gray sandstone and shale. The rest of the soils, which occur mainly on the higher hills of the eastern and southeastern parts of the county, are red or brownish red, owing to the brown and red rock materials predominating in the mineral composition.

All the soils have been developed from materials transported and modified to a greater or less extent by the action of glaciers which in past ages moved over this section. The movement of the glaciers brought in some foreign materials which occur less plentifully on the more elevated situations than in the valleys. The valley floors of the larger valleys have considerable deposits of weathered materials, most of which evidently have been transported many miles from the north. In addition to these materials in the valleys is the recent alluvium which, during periodic overflows of the streams, is still in the process of deposition.

The soils of the county may be associated in several groups according to the section in which they occur: (1) Light-colored soils of the uplands, derived largely from fine-grained gray sandstones and shales; (2) red soils of the uplands, derived or noticeably influenced by coarser grained brown sandstone and red shales; (3) soils developed on terraces, or second bottoms, from sandstone and shale materials reworked and more or less assorted in their deposition; and (4) soils of the first bottoms formed from recent-alluvial deposits.

An excavation in a soil reveals a series of layers, or horizons, called collectively the soil profile. The characteristics of the profile,

[5] On the soil map of Broome County, it will be noticed that the soils do not everywhere join along the county lines with those shown on the soil maps of Cortland County (1916) and Chenango County (1918). These discrepancies are owing, in part, to the greater detail of mapping in more recent surveys and, in part, to recognition of the Canfield series of soils in Broome County. These soils are intermediate in soil characteristics and in drainage conditions between the Volusia soils and the Wooster soils, and in the older soil surveys were included in those series.

so far as these can be obtained by observation in the field or by simple laboratory tests, determine how the soil is classified. In soil classification, as developed in the United States, the soil series is the fundamental unit. The series is divided into types on the basis of texture of the surface soil, and the types into phases, according to minor variations, such as differences in stoniness and relief that are of importance in land use but are not expressed by actual soil differences. The series is given a geographical name, taken from the location in which the included soils were first recognized. The types within the soil series are named according to the texture of the surface soil, as sand, sandy loam, silt loam, or clay. The type name, added to the series name, gives the complete name of the type. For example, in this county, Lordstown is the name of a series; Lordstown gravelly silt loam, the name of a type; and Lordstown gravelly silt loam, steep phase, the name of a phase, or slight variation from the type.

In the following pages, the soils of Broome County are described in detail, and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 5.

TABLE 5.—*Acreage and proportionate extent of soils mapped in Broome County, N. Y.*

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Lordstown gravelly silt loam	83,008	18.4	Chenango silt loam	5,184	1.1
Lordstown gravelly silt loam, steep phase	4,992	1.1	Chenango silt loam, rolling phase	512	.1
Lordstown stony silt loam	9,472	2.1	Chenango gravelly loam	6,272	1.4
Lordstown stony silt loam, steep phase	41,600	9.2	Chenango gravelly loam, broken phase	1,600	.3
Bath silt loam	3,648	.8	Chenango fine sandy loam	3,008	.7
Wooster silt loam	11,968	2.7	Howard gravelly loam	5,312	1.2
Wooster gravelly loam	4,160	.9	Howard fine sandy loam	512	.1
Wooster gravelly loam, steep phase	1,216	.3	Unadilla silt loam	448	.1
Canfield silt loam	6,400	1.4	Otisville gravelly loam	2,176	.5
Canfield gravelly silt loam	82,112	18.2	Chagrin silt loam	2,688	.6
Canfield gravelly silt loam, steep phase	8,320	1.8	Chagrin fine sandy loam	960	.2
Canfield gravelly silt loam, shallow phase	4,160	.9	Tioga silt loam	19,136	4.2
Langford gravelly silt loam	1,152	.3	Tioga silt loam, high-bottom phase	1,024	.2
Chippewa silt loam	5,888	1.3	Tioga silt loam, alluvial-fan phase	4,416	1.0
Volusia silt loam	84,160	18.7	Tioga fine sandy loam	960	.2
Volusia silt loam, steep phase	2,304	.5	Middlebury silt loam	384	.1
Fremont silt loam	2,368	.5	Holly silt loam	2,560	.6
Lackawanna silt loam	1,024	.2	Meadow	1,920	.4
Lackawanna stony silt loam	5,312	1.2	Peat	512	.1
Walton silt loam	5,376	1.2	Rough stony land	9,728	2.2
Culvers gravelly silt loam	13,184	2.9	Gravel pits	64	.1
			Total	451,200	

LIGHT-COLORED SOILS OF THE UPLANDS

In the soils of this group the mineral constituents are derived largely from fine-grained sandstones and shales, which underlie the soil mass. The parent soil materials are, however, not strictly residual, as glacial action has influenced them to some extent. The underlying rocks are not normally lime-bearing. Some rock materials, such as small quantities of quartzite fragments, have been carried from considerable distances, and evidently some lime-bearing materials, as evidenced by limy and alkaline conditions, formed in the lower subsoil layers and in places in the upper parts of the subsoil.

The soils in this group occupy rolling, sloping, or hilly country, with comparatively narrow ridges and normally smooth slopes as they descend to the valley levels. In the more deeply dissected areas, many of the slopes are steep or rather precipitous, and they represent the extreme condition classed as rough stony land. The variation in the topography, according to the thickness of the soil mantle over the underlying rock, together with differences in drainage conditions, have largely determined the differences among the several soils of the group.

The ridge tops, for the most part, have a shallow soil mantle, averaging not much more than 3 feet in thickness over the bedrock. There is little or no compactness in the subsoil, and yellow colors predominate. These soils are identified as members of the Lordstown series. Farther down the slopes from the Lordstown soils drainage conditions, as a rule, are less well developed and the soil material is thicker, which has favored the development of dense or hardpan subsoils at various depths. Where drainage is moderately well developed and the friable yellow surface soil materials range from 12 to 18 inches in thickness over the dense subsoil, the soils are classified in the Canfield series. In somewhat lower areas of mild relief, especially where seepage from the higher positions has developed deficient drainage, the hardpan lies closer to the surface, more mottled conditions prevail, and the surface soil is somewhat darker. This soil condition distinguishes the Volusia series. Where drainage conditions are still less well developed, and the land is water-logged in wet seasons, causing mottled soil coloring with a dark-colored or, in places, a somewhat mucky surface covering, the soils are classified in the Chippewa series. A departure from the Canfield soils, which have an acid reaction, is recognized in the few areas of Langford soils, in which the compacted subsoil shows an alkaline reaction. In other areas, usually associated with the Canfield soils, the soil has not developed an appreciably compacted subsoil, and to a depth of several feet the material is friable and well drained. Such soils are identified as Wooster soils.

Lordstown gravelly silt loam.—Lordstown gravelly silt loam has a wide distribution throughout all except the southeastern part of the county. As this soil occupies the tops of ridges, the thickness of soil material over the rock is comparatively slight.

The surface soil of cultivated areas is friable brownish-yellow or grayish-yellow silt loam extending to the depth of plowing. Beneath this is brownish-yellow or pale-yellow friable silt loam which may continue to bedrock but in most places extends to a depth ranging from 30 to 40 inches. Immediately over the rock in many places is a thin layer of compact dense yellow soil material mottled somewhat with gray and brown, which indicates intercepted drainage in the downward movement of soil water, although drainage as a whole is well established. Mixed with the soil material are various quantities of angular sandstone gravel, some shale, and small platy stones. Most of the larger stones have been removed from cultivated fields.

Associated with Lordstown gravelly silt loam, in the western and northwestern parts of the county, are a few scattered areas having poor drainage, in which the soil mantle is shallow over the bedrock.

This development occurs on flat divides and slopes. In general the topsoil consists of dark-gray fairly friable silt loam containing a moderate quantity of shale chips and angular gravel, and below plow depth the soil material is rather compact dull-yellow silt loam mottled with dark brown and yellow. The compactness and mottlings become more pronounced to a depth ranging from 24 to 30 inches, where more brittle laminated shaly clay occurs, grading below into beds of raw shale rock. The shallowness and the intercepted subsoil drainage render the land of low agricultural value, but grass and forage crops do fairly well.

Another variation of Lordstown gravelly silt loam occurs in the extreme southeastern part of the county, occupying high-lying positions where the soil material has but slight depth over bedrock. This soil has a light-brown or grayish-brown gritty silt loam surface soil which, at a depth ranging from 4 to 8 inches, overlies light-brown or yellowish-brown gritty silty or loamy material, and this, in turn, at a depth ranging from 2 to 3 feet, rests on the rock. Aside from the somewhat duller brown color and more gritty texture, the soil closely resembles typical Lordstown gravelly silt loam and has about the same productive value.

The organic-matter content of Lordstown gravelly silt loam, originally low, becomes depleted easily with cropping, although it is maintained readily when care is exercised. The entire soil mass has an acid reaction.

Perhaps from 40 to 50 percent of this soil is cleared farming land, and the rest supports a hardwood tree growth characteristic of the region. The utilization of this soil depends greatly on its accessibility. Where public highways cross it, much higher development is attained than in areas reached only by steep poor roads. Many such areas are reserved for pasture or are forested.

This land is used for general farm crops and pasture for dairy cows. It is only moderately productive of most crops, although good results may be obtained under good farming methods. Silage corn, oats, buckwheat, some millet, and grass are the crops commonly grown. Potatoes are perhaps best adapted to this soil, as fair yields of good quality potatoes can be obtained. Acre yields of silage corn range from 6 to 8 tons, oats from 25 to 40 bushels, buckwheat from 20 to 30 bushels, hay from 1 to 1½ tons, and potatoes from 100 to 150 or more bushels.

The better farmed areas receive liberal applications of stable manure, so far as possible, once in a crop rotation, supplemented with commercial fertilizers—either complete mixtures or superphosphate. In order to insure success with clovers and other legumes, as well as best results with most other crops, it is necessary to apply lime at the rate of 1 or 1½ tons an acre once in a rotation, or every few years, to correct the usual acid conditions. This is essential for satisfactory stands of clover, especially the red variety. In many localities some of this soil has been abandoned for cultivated crops and is used to some extent as pasture or mowing land.

Lordstown gravelly silt loam, steep phase.—Lordstown gravelly silt loam, steep phase, includes areas occurring in association with typical Lordstown gravelly silt loam, which have such a sharp slope that they cannot be cultivated easily, the broken soil is likely to wash

badly, and the land is too steep to maintain in good productive condition. Most of it is used as permanent pasture or forest land.

Lordstown stony silt loam.—Lordstown stony silt loam, which is associated with Lordstown gravelly silt loam, caps the tops of hills and occurs on some of the slopes. It is a thin stony variable soil with many exposures of bedrock and loose detached blocks of rock. It has practically the same characteristics as Lordstown gravelly silt loam, aside from the higher rock content.

This shallow stony soil occurs in rather small widely separated areas, mainly in the southern and northwestern parts of the county. The total area is small. The value of this land is low, owing to its inherent character, consequently most of it is used for forestry or pasture.

Lordstown stony silt loam, steep phase.—Lordstown stony silt loam, steep phase, occupies the steeper, rougher, and more broken areas of Lordstown stony silt loam, which are too steep or sloping to cultivate regularly. The surface relief ranges from that of the typical soil to that of the steep somewhat precipitous and stony areas classed as rough stony land. The main difference from the typical soil is one of surface relief rather than of soil condition, but this soil includes more seeped spots, as a result of exuding water from the underlying rock layers. Some of the more gently sloping areas are cropped, but most of the land is used as permanent pasture or is forested.

Bath silt loam.—Bath silt loam closely resembles Lordstown gravelly silt loam but differs slightly in structure, which in many places is somewhat more open than that of Lordstown silt loam, and has a greater depth of soil material over the bedrock. The most noticeable characteristic in many places is the smaller gravel and stone content in contrast with that of Lordstown gravelly silt loam. A few areas of Bath silt loam are almost stone-free.

Bath silt loam predominates in the northern part of the county, particularly east of Otselic River and lower Tioughnioga River, where it is developed on the higher ridge and hill tops. This soil is used in about the same way as is Lordstown gravelly silt loam. Its somewhat smoother surface and easier accessibility make it somewhat more desirable farming land than much of the Lordstown gravelly silt loam.

Wooster silt loam.—Wooster silt loam, associated with the Canfield and Lordstown soils, occurs mainly in lower slope and bench-like positions along most of the larger and many of the smaller valleys. It occurs mostly in disconnected strips ranging from one-fourth to three-fourths of a mile in width. The surface relief ranges from moderately smooth to sharply sloping or rolling, although most of the land is smooth enough to be easily cultivated. Drainage is well established.

The surface soil has a characteristic light-brown or somewhat grayish brown color and is friable and easily worked. Below plow depth, the material is dull-brown friable silt loam changing within a few inches into bright brownish-yellow silt loam, in places containing dark-colored streaks of material seemingly filtered down from above. In most places firmly bedded yellowish-brown or dull brownish-yellow friable silt loam continues to a depth of more than

3 feet. In places some hard or moderately compacted material is present at a depth ranging from 40 to 50 inches but is not nearly so pronounced as in the Canfield and Volusia soils. Some staining or faint mottling may occur in the lower part of the subsoil. Both surface soil and subsoil are acid in reaction.

Some areas immediately north of Kattelville have a much yellower and less brown color from the surface downward than the more typical areas. Most of them occur at higher levels leading up to areas of Lordstown gravelly silt loam, and the color distinction seems a characteristic in common with the Lordstown soil.

In some areas more or less platy stone and angular gravel occur, some of which are water-worn, but as a whole, this soil is freer of rock fragments than is Canfield gravelly silt loam. The fine texture of the soil enables it to hold moisture well, and its friability allows excess moisture to escape readily. Good drainage and favorable soil structure favor the effective use of lime and fertilizer, and the land responds readily to good farming methods. It is one of the best upland soils for the production of crops supporting dairying, and well-managed land returns good average yields of silage corn, oats, and hay, in addition to other forage crops. Potatoes, root crops, and other vegetables yield well. Probably 65 or 70 percent of this soil is cleared tillable and pasture land.

Wooster gravelly loam.—Wooster gravelly loam occurs mostly in the northern part of the county along the slopes of Tioughnioga River Valley and along Dudley Creek. One area is in the western part of the city of Binghamton and another near Vallonia Springs. This soil occupies positions similar to those occupied by Wooster silt loam, although most of it lies at lower levels.

The soil characteristics of the finer material are similar to those common to Wooster silt loam, but the sand content is sufficiently high to impart a gritty feel. The most noticeable characteristic is the rather large content of rounded and angular gravel, which makes the soil somewhat difficult to cultivate, looser, and less retentive of moisture.

In places, especially along the margins of slopes facing the larger valleys, some of the materials show modified cross bedding or irregular stratification, a condition characteristic of the Chenango and and Otisville soils.

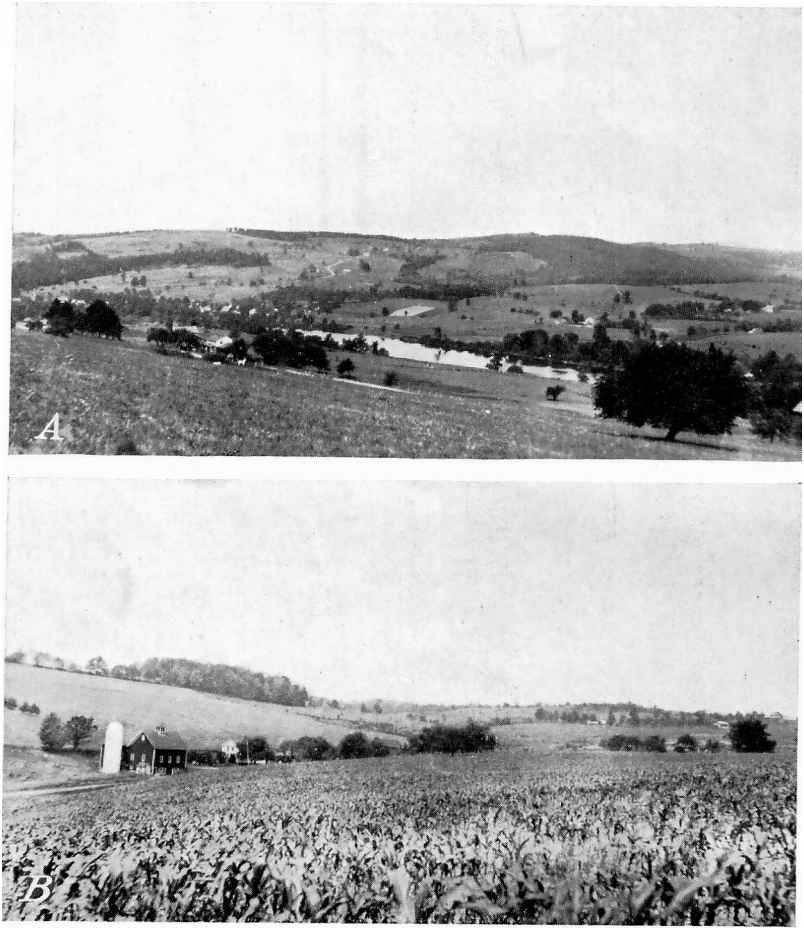
Where well developed this is a good farming soil.

Wooster gravelly loam, steep phase.—Wooster gravelly loam, steep phase, includes areas of Wooster gravelly loam, in which steepness of slope or the presence of gullies and ravines renders the land unsuitable for profitable cultivation. It occurs only in the northern part of the county, associated with areas of typical Wooster gravelly loam. The utilization of this soil is confined almost entirely to pasture and wood lots.

Canfield silt loam.—Canfield silt loam occurs only in the northwestern part of the county, mostly north and east of Whitney Point. This soil occurs in positions similar to those occupied by Canfield gravelly silt loam, but the surface relief is much milder and the soil is much freer of stones than is the gravelly soil.

The surface soil of Canfield silt loam is grayish brown or light brown, contains a moderate quantity of organic matter, ranges from

A, Farm land in Susquehanna Valley south of Windsor. Hills in background are in Pennsylvania. *B*, Farm land of decided slope north of Sanitaria Springs. Recently worked Canfield gravelly silt loam in foreground.



A, Characteristic relief and distribution of farm land and wooded land in Susquehanna Valley near Ouaquaga, looking west from the north side of Rumble Mountain. *B*, Representative farm south of Sanitaria Springs. Soils in low ground are largely Volusia silt loam, with Lordstown and Canfield soils occupying higher elevations.

loam to silt loam in texture, is friable, and is easily worked. Below the usual plow depth, the material is brown or light-brown friable crumbly silty loam becoming paler in color and less friable with increase in depth. At a depth of about 18 or 20 inches, the soil is faintly mottled, is increasingly compact, and within the next few inches assumes a dense hardpanlike structure. It is dull gray in color, mottled noticeably with gray, rust brown, and yellow. The hardpan, where exposed, is difficult to pulverize when either dry or moist, and it resists the downward movement of soil water. In most places moderate quantities of small platy stones and angular gravel are mixed with the soil material, but here and there the soil is comparatively free of stone fragments. The surface soil to plow depth and the upper soil layers are naturally acid in reaction, but they become less acid with increase in depth, and the denser subsoil, at a depth of about 30 or more inches, may be almost neutral and in a few places is apparently alkaline.

Surface drainage is good and internal drainage fair, save for the obstruction caused by the dense subsoil. In a few places small included areas of Volusia and Chippewa soils, or sluggishly drained alluvial lands, give rise to a less well drained condition.

This soil is deficient in humus, or organic matter, and lacks lime carbonate for the best results with most crops, and fertilization is needed to meet these deficiencies. Where these requirements have not been met, crop yields are low and grass soon runs out, being replaced by such weedy plants as goldenrod, daisy, poverty grass, devil's-paintbrush, sorrel, cinquefoil, and wild dewberry. Under good farm management this soil returns good average yields. The range of crops grown, yields, and general management are about the same as on the other Canfield soils and the Lordstown soils, but the somewhat less stony character and the generally smoother surface relief give Canfield silt loam some advantage as farm land.

Canfield gravelly silt loam.—Canfield gravelly silt loam has a wide distribution in Broome County, except in the extreme southeastern part, occurring in all parts of the uplands in association with Volusia silt loam, on valley slopes, low divides, or ridges.

The surface soil in cultivated fields generally consists of dull grayish-brown friable silt loam, with only a moderate content of organic matter to plow depth; but in forested areas and in fields long supporting a grass cover, the color is darker in the topmost few inches, owing to the presence of larger quantities of humus, or decayed vegetable matter. Below a depth of about 7 inches, the material is brownish-yellow friable silty loam which, with increasing depth, becomes lighter in color and less friable. Below a depth ranging from 16 to 20 inches, the soil material is less friable and is mottled with pale rust brown, gray, or dull brown. This grades rapidly into more or less dense and compact dull yellowish-brown silt loam, in most places of hardpan consistence, containing mottles of rust yellow and gray, and dark-brown streaks. Below a depth ranging from 30 to 40 inches, the material is in general somewhat less dense and compact.

On the surface and mixed throughout the soil mass are various quantities of sandstone fragments, ranging from flaggy or platy pieces to angular coarse and small gravel, and some shale chips in

places. Most of the larger fragments have been removed from the fields, but in many places the stone content makes cultivation more or less difficult.

The soil material to a depth of several feet is acid in reaction, although the subsoil in many places is less acid than the surface soil. As mapped this soil includes small areas, in which the subsoil, within a depth of 3 feet, is alkaline. Such areas are composed of Langford silt loam but are too small in extent or too irregular in occurrence to be shown separately on the soil map.

Also included within mapped areas of Canfield gravelly silt loam are many small areas of Volusia silt loam and Chippewa silt loam, small alluvial bands along small streams, or areas of the steep phase of Canfield soil. The occurrence of these results in a single cultivated field showing several different soil conditions.

In some of the more elevated positions, as a few of the divides or saddle positions, the soil material has a somewhat lighter color and apparently consists of a purer sandstone and shale composition. Although not mapped separately in this county, such soil, where better developed in other counties in the State, has been mapped as Mardin silt loam. Typical examples occur from 2 to 3 miles northwest of Choconut Center and 2 miles southwest of Belden.

The prevailingly rolling or sloping surface relief of this soil insures good surface drainage, but the dense subsoil retards free underdrainage to the extent that excess water escapes a little sluggishly. Probably 60 or 70 percent of the land is cleared arable and pasture land (pl. 1, *B*).

Canfield gravelly silt loam, considering its wide extent and total area, is probably the leading agricultural soil of the uplands. Probably no single farm consists entirely of this soil, and most farms have various acreages of other soils, possibly better types, such as Wooster, Langford, or Tioga soils, or inferior types, as steeper phases of the soils named, or the Volusia or Chippewa soils.

This soil does not have a large natural supply of organic matter and is not especially well adapted to corn, but it returns good yields of oats and grass crops. Not having a natural supply of lime in its present development, it is not a good soil for legumes, such as red clover, vetch, and especially alfalfa, but does give good yields of potatoes which thrive in an acid soil. Amending the soil by adding organic matter in the form of stable manure and green-manure crops, and by applying lime, this soil may be readily improved and made to produce more profitable yields of these and other crops. The greater parts of the crops grown are used in connection with dairying. Most of the corn is grown for silage or fodder, and oats are grown to furnish feed for horses and to provide a convenient crop in the rotation preparatory to seeding to grass.

Corn for silage yields from 6 to 7 tons an acre, oats from 40 to 50 bushels, and hay from 1 to 1½ tons. Well-fertilized and limed land always produces larger yields, especially of clover which may yield more than 3 tons an acre. Potatoes, although not grown extensively, give good average yields. Other crops, such as buckwheat, millet, barley, wheat, and many vegetable crops, produce satisfactory yields.

Canfield gravelly silt loam, steep phase.—Canfield gravelly silt loam, steep phase, includes hillside slopes which, because of their

steepness, make cultivation difficult and if cultivated render the loosened soil subject to destructive erosion. Comparatively little of the soil of this phase is cultivated, and very little is kept in a regular rotation. Perhaps 30 percent of the land is cleared and is used mostly for pasture. The rest supports a tree growth common to this section. Most areas of this soil have a somewhat larger content of small platy stones and angular gravel than does the typical soil, owing in large measure to the fact that the steep phase remains unimproved, whereas on the smoother areas of typical soil most of the larger stones have been removed to facilitate cultivation.

Canfield gravelly silt loam, shallow phase.—The shallow phase of Canfield gravelly silt loam is associated with both the typical soil and with areas of Lordstown gravelly silt loam. It is characterized by its shallowness over the bedrock or, in places, by rock exposures at the surface. It has the dense subsoil characteristic of the Canfield soils. The surface relief ranges from steep to sloping, and most of the land is not well suited for cultivation. Most of it is forested or where cleared is used for pasture. Only a few areas are mapped in the northern part of the county, and some scattered areas are mapped with Canfield gravelly silt loam, steep phase, in other parts.

Langford gravelly silt loam.—Langford gravelly silt loam, in general appearance of the soil material and surface configuration, appears practically identical with Canfield gravelly silt loam, but it differs from the Canfield soil in that the compact subsoil shows an alkaline reaction, although no free carbonates are present. The surface soil, although acid, or sour, in many places supports a more abundant stand of grasses and vegetation. This is a slightly better soil than Canfield gravelly silt loam. The principal areas are northwest of Endicott, in the vicinity of Conklin, and about 3 miles northeast of Damascus.

Chippewa silt loam.—Chippewa silt loam is well distributed throughout the uplands, where it is associated mainly with the Canfield and Volusia soils and to less extent with the Lordstown soils. It occurs in poorly drained strips and irregular-shaped areas where drainage from surrounding higher lying soils passes through or onto these areas. The many springs occurring in areas of this soil keep it continually more or less wet.

The variable drainage conditions, ranging from almost marshy to those approached in Volusia silt loam, prevent the development of very definite soil characteristics. The surface material in most places is dark and in some places is mucky, and the material beneath is universally mottled and is more or less dense and impervious.

The average surface soil consists of dark grayish-brown, dark-gray, or nearly black silt loam or silty clay loam, slightly mottled or flecked with brown or darker marking. Below a depth ranging from 6 to 10 inches, lighter colors and more noticeable mottles of rust yellow and orange yellow occur, and the material becomes slightly friable. The material is more dense and, in many places, approaches hardpan conditions at a depth ranging from 20 to 24 inches. Here the color becomes bluish gray streaked with rust yellow, brown, or purplish brown. So far as could be observed, all the soil material is acid in reaction, and more or less platy sandstones and angular gravel occur on the surface and within the soil mass.

In the eastern part of the county a few areas are included with this soil, which have considerable quantities of ruddy-brown or somewhat red materials in the soil composition. These areas really are Norwich silt loam, but because of their small extent and lack of agricultural importance, they are included with Chippewa silt loam in mapping.

Little use is made of the areas of Chippewa silt loam, save for pasture or, possibly, mowing land, if the surface is sufficiently smooth and the grass of acceptable quality. Many areas support a mixed growth of trees and brush. Grasses are inclined to be coarse and reedy, and the difficulty in preparing a seedbed discourages farmers in establishing stands of the more palatable grasses. In places drainage is improved by open ditches.

Volusia silt loam.—Volusia silt loam is well distributed over most of the county, except the extreme southeastern part. It is closely associated with Canfield silt loam and Chippewa silt loam, but it is less well drained than the Canfield soil and better drained than the Chippewa soil.

The surface soil of Volusia silt loam in cultivated fields is grayish-brown rather mellow silt loam having a moderate content of small platy stones and angular gravel of sandstone origin. This material passes into dull-yellow moderately friable silt loam which, at a depth ranging from 10 to 15 inches, grades into compact streaked or mottled bluish-gray and ruddy-yellow silt loam. This material grades, in turn, within a few inches, into a compact dense hardpan of silt loam or silty clay loam of general light bluish-gray color, mottled with yellowish brown, black, and brown. The bluish-gray material, when moist, has a slick soapy feel. The hardpan condition ordinarily continues downward several feet, although the lower part may be less compact. Various quantities of angular sandstone gravel and small stones, together with some shaly chips, are mixed through the soil mass.

The depth to the hardpan differs somewhat from place to place. In some places this layer may be comparatively close to the surface, causing a mottled compact condition almost up to plow depth, and in other places it may lie rather deep, representing an approach to Canfield silt loam.

A few shallow stony areas occur only in the northern part of the county, chiefly northeast of Penelope and northeast of Itaska. They include old glacial drainage channels and slopes where glacial erosion has left the soil shallow and stony. Some small less well drained included areas approximate Chippewa silt loam in characteristics. The unfavorable surface relief and drainage conditions limit the use of such land to pasture and forestry.

Numerous areas of Volusia silt loam occupy the lower valley slopes leading down from higher elevations occupied by Lordstown and Canfield soils (pl. 2, *B*), and much of the Volusia soil occurs in the flat areas around the heads of streams and in broad depressions between ridges. The peculiar soil conditions are the result of the sluggish run-off and seepage of water from higher levels, in addition to the direct rainfall. Internal drainage is poor, and surface drainage is deficient. Both the surface soil and subsoil are acid in reaction.

About 60 percent of the total area is cleared sufficiently for use as tillable or pasture land. This soil is used extensively in connection with associated soils, and some of it is included in practically every farm. Because it has deficient drainage and a high water table, it is not well suited for the best crop production. Plowing and other tillage operations, unless performed under optimum moisture conditions, are likely to leave the soil cloddy; when too dry the soil does not break down readily, and when too wet it forms clods which are difficult to work into a satisfactory seedbed. During dry seasons the soil tends to contract, and large cracks open, especially on grassland and insufficiently tilled fields. The naturally acid soil condition and deficient drainage do not favor good grass stands, and on land not limed and replenished with organic matter the better grasses soon give way to various weedy plants, especially buttercup, poverty grass, goldenrod, sorrel, and daisies. Land that is carefully plowed and cultivated, and suitably limed and fertilized, will produce fair crop yields. Volusia silt loam is not a good soil for corn, as it is rather too shallow, wet, and too cold in the spring to allow the crops to obtain a favorable start. Grass crops and the small grains are better adapted, and buckwheat seems fairly well suited to this soil. The naturally acid condition, together with deficient drainage close to the surface, is especially unfavorable to clovers, especially the red variety, and to less extent to alsike. White clover is fairly successful, but alfalfa usually fails. A few of the better areas, when suitably limed and fertilized, produce satisfactory stands of red clover. Potatoes and root crops make poor yields. Many of the comparatively smooth areas, especially those adjacent to farm buildings, are cultivated, and other cleared areas, but more remote and less smooth, produce fair pasture for dairy farms.

Depending on the state of productiveness attained, acre yields on this soil range from 3 to 6 tons of silage, 25 to 40 bushels of oats, 15 to 20 bushels of buckwheat, and one-half ton to 1½ tons of hay.

Volusia silt loam, steep phase.—Volusia silt loam, steep phase, includes areas of Volusia silt loam much steeper than those occupied by the typical soil. It occurs as small scattered areas on slopes where seepage from higher lying land has kept the soil wet for considerable periods. A few small benchlike areas are included. Practically all this steeper land is used for pasture or forests.

Fremont silt loam.—Fremont silt loam occurs in association with Volusia silt loam in the southern part of the county and to less extent in the northern part. It differs from Volusia silt loam in having a more friable subsoil, especially in the upper part, where the material, though more or less mottled and moderately compacted, affords somewhat easier root penetration and freer movement of soil moisture. It may be considered a slightly better soil than Volusia silt loam.

RED SOILS OF THE UPLANDS

Soils of this group occupy 10 percent or more of the county and occur in the extreme southeastern part. The limits of the area covered by these soils are not well defined, but, in general, the area is bounded on the north by Oquaga Creek. Other bodies of soils belonging to this group lie as far north as North Sanford and in

scattered areas as far west as Hawleyton. These soils are characterized by brown or red colors and by coarser grained rock materials. This section of the county generally is much more deeply dissected, valley slopes are more abrupt, and the contours of hills are less well rounded than in the central and western parts. The more rugged character of the land renders it less desirable for farming.

The native rocks underlying the soils of this area are brown or red, and this characteristic largely governs the soil colors. The coarser grained, more massive rocks have the browner colors, and the more thinly bedded rocks and shales have the redder colors and furnish the finer textured soil materials.

The redder soils developed from the redder rocks, especially those having a larger shale content, are recognized in the Lackawanna series. Normally these soils have a dense or hardpan subsoil, although the mantle of soil material over the rocks is comparatively thin. Drainage is good. A similar soil derived from gritty red material, which has a paler red color and a hardpan subsoil obstructing internal drainage, is classed in the Culvers series. Along many of the valley slopes, ordinarily at lower levels, are soil areas in valley-fill positions, with somewhat red surface soil material of considerable thickness, underlain by a hardpan subsoil. These are the Walton soils.

The reddish-brown or brownish-red soils of this group are comparatively dark colored. This color characteristic aids the soils in absorbing and retaining heat and in supporting a normal plant growth.

Lackawanna silt loam.—Lackawanna silt loam occurs in the southern part of the county where, with the related Lackawanna stony silt loam, it caps some of the higher hills. Its best development is just southeast of Hawleyton.

The surface soil of Lackawanna silt loam is dark ruddy-brown friable silt loam containing a moderate quantity of shale chips and angular sandstone gravel, which also prevail in the subsoil layers. Below the cultivated layer is brownish-red friable silt loam changing within a few inches to dull-red or Indian-red shaly silt loam. Below an average depth of about 20 inches is a mixture of shaly and silty dull-red material, in most places compacted into a dense hardpan, which, at a depth ranging from 30 to 40 or more inches, grades into unmodified beds of red sandstone and shales. The hardpan, however, is not so dense that it retards the downward movement of water.

The cultivated soil, although a silt loam, contains sufficient coarse particles to give it a gritty feel, and the material breaks up crumbly when plowed and worked. It contains a fairly liberal quantity of organic matter. The reaction of the surface soil and subsoil layers is normally acid.

Most of the land has been cleared of timber, and much of it is or has been cultivated. This land produces good average yields of all the crops grown in connection with dairy farming. Grass stands are in general good, and pasture grasses maintain their growth well. With additions of lime and stable manure excellent stands of clover are obtained.

Lackawanna stony silt loam.—Lackawanna stony silt loam occurs in larger areas than does the related Lackawanna silt loam. It differs from the silt loam chiefly in that it has much rougher surface relief, a more plentiful stone content, and is shallow over bedrock. Practically all of it is less than 3 feet thick, and in many places bedrock is exposed. Many large detached blocks of rock occur on the surface, and some areas approximate rough stony land in character. Areas of this soil occupy high exposed positions.

The soil, where of sufficient depth, is about the same as Lackawanna silt loam, though most of the shallower areas have little or no dense subsoil layer. Here and there shaly variations occur, which are generally of a more intense Indian-red color and rather shallow. Many of these areas are in cultivation and are known locally as "shell-rock" or "red-shell land". Such land is recognized by farmers as desirable for potatoes, and fair yields of good-quality potatoes are produced. Most of this soil, probably more than 80 percent, supports a forest growth composed of maple, beech, some oak, and pine. The more or less cleared areas are used largely for pasture, although the shallowness of the soil and its rocky character are not favorable for the best growth of pasture grasses.

Walton silt loam.—Walton silt loam occurs as red or brown valley-fill soil occupying the lower valley slopes in the southeastern part of the county. In most places it lies lower than the associated Culvers gravelly silt loam and in many places extends upward toward steep areas of rough stony land.

Normally this soil resembles Lackawanna silt loam in color and in profile development, but in Broome County the soil color is less red and more brown in most places, which is a departure from the better developed areas in Delaware County. The soil material in most areas is 10 feet or more thick and in many places more than 40 feet.

The surface soil of Walton silt loam is light-brown friable silt loam, in many places having a ruddy cast, containing some angular gravel and small sandstone fragments. Below the cultivated soil layer is ruddy-brown or light reddish-brown friable silt loam which becomes slightly compact and less friable at a depth of 16 or 18 inches, where it becomes deeper brown. This material, at an average depth of 20 inches, is underlain by a dense hardpan of dull-brown color mottled and streaked with gray, yellow, and darker brown.

Drainage ranges from good to fairly good, and excess rain water drains readily from the surface. This soil has good moisture-holding capacity. Seepy places occur here and there along the slopes, causing small areas to be less well drained.

A large proportion of this soil is tillable, or potentially so, and probably more than 25 percent of the total area is improved land. Most of it lies near or adjacent to valley roads, and many farmsteads are located on or near areas of it.

The soil is well adapted to the usual range of crops needed to support dairy farming and with proper management produces good yields of corn, oats, forage crops, and pasture grasses. Good stands of red clover are obtained with the use of lime, and alfalfa also is grown, although the subsoil is somewhat too dense for best results with this crop.

Culvers gravelly silt loam.—As Culvers gravelly silt loam is light red or yellowish red, it is intermediate in color between the Canfield and Lackawanna soils. It occurs in the southeastern part of the county, associated with the Lackawanna and Walton soils, and is a transitional soil leading toward the distinctly yellow soils.

Culvers gravelly silt loam has a grayish-brown friable silt loam surface soil underlain by friable light ruddy-brown or ruddy-brown subsurface material. At a depth ranging from 15 to 18 inches is slightly mottled light-brown less friable silt loam which, within a depth of a few inches, grades into a dense hardpan of generally brown color mottled with dark brown streaked with gray, which retards the downward movement of water. All the soil material shows an acid reaction.

The rolling, undulating, or sharply sloping surface relief insures fairly good surface drainage, but the dense subsoil layers retard internal drainage. Many small seepy spots occur, in which the soil resembles Chippewa silt loam.

In areas of this soil occurring at the higher elevations in the extreme southeastern part of the county, the surface relief ranges from sloping and undulating to rolling, and the slope of the land is sufficient to insure fairly good surface drainage. The surface soil here consists of dark-brown friable slightly gritty silt loam. Below a depth of 6 or 8 inches, the soil remains friable and the color becomes lighter, grading into light brown. At a depth of about 18 or 20 inches, the material increases in compactness and, within a few inches, approximates a hardpan of generally ruddy-brown color mottled with brown, black, and in places purple streaks. The dense mottled material continues to a depth of 3 feet or deeper, below which the compactness gradually decreases. On the surface are moderate quantities of loose platy brown coarse-grained sandstones and some of gray color, ranging from several inches in diameter to small angular gravel. Similar rock fragments are embedded in the soil mass. In cultivated fields the larger fragments have been removed and piled into fence rows. The soil material in all layers is acid.

Culvers gravelly silt loam is a fairly good agricultural soil and produces about the same crop yields as Canfield silt loam, but it supports a somewhat better stand of native grasses. Cultivated fields are productive for the general range of crops. From fair to good stands of mixed grasses are maintained, and the pastures consist mainly of bentgrass, white clover, and Kentucky bluegrass. All the farms are of the dairy type, and the crops and the general farm practices conform to this industry. Perhaps 60 or 70 percent of this high land is cleared pasture and plow land, the plow land probably not exceeding 25 percent.

SOILS OF THE TERRACES, OR SECOND BOTTOMS

The soils of this group occupy low bench, or terrace, positions, usually along the outer valley floors of the larger valleys, above overflow of the present streams. The soil materials were laid down during the glacial epoch, when the waters were flowing at higher levels and water currents were swifter and more variable. In general, these soils are more variable in texture and surface configura-

tion than the soils of the lower lying stream bottoms. The terrace soils typically are well drained, owing to the fact that most of them have gravelly loose porous subsoil layers. The surface soils for the most part are of sufficiently heavy texture to make desirable farm land. Most of these soils have favorable surface features, and the land is readily accessible for conducting farm operations. The soil materials have been more or less thoroughly reworked by action of glacial waters, and the gravel and sand constituents are more or less rounded and water-worn. Most of the rock materials are of sandstone and shale origin, but some materials in the subsoil are of limestone origin. Most of the limestone material occurs along the Tioughnioga and Chenango River Valleys where the glacial ice carried it from the limestone region farther north in the State. The presence or absence of limestone or limy materials in these soils affects their agricultural value and forms a basis for their classification.

Those soils developed largely from sandstone and shale materials and underlain by porous gravels and sands are classified as Chenango soils. These soils generally occur in level areas, and the heavier textured types, especially Chenango silt loam, make desirable farm land. As Chenango gravelly loam is a little more open and porous, it tends to be slightly more droughty. A soil which is somewhat different from the Chenango soils, occurs where the land surface is irregular and where the soil materials have no very consistent arrangement but are loose and porous to the extent that the soil is rather droughty. This is Otisville gravelly loam. Both the Chenango and Otisville soils are acid. The soil developed on the smooth terraces, that has 3 feet or more of fine material over the gravel, is classed as Unadilla. Those soils of this group whose subsoils contain limestone or limy materials are classed as Howard soils, the textural arrangement of which is the same, or about the same, as that of the Chenango soils, but the presence of calcareous materials at a depth ranging from 3 to 4 feet, within the range of roots of such crops as alfalfa, makes the Howard soils of somewhat higher agricultural value.

Chenango silt loam.—Chenango silt loam occurs in the larger valleys, the greater part of it along Susquehanna River in well-distributed detached areas, most of which are somewhat elongated strips ranging from about one-fourth to one-half mile in width. The largest continuous area is southeast of Harpursville.

In most of the cultivated areas, the surface soil is light-brown or dull grayish-brown friable silt loam, beneath which is yellowish-brown friable silt loam that, with depth, becomes a little more firmly bedded. At a depth ranging from 20 to 24 inches, the material changes to more or less loose and porous rounded gravel mixed with sand and some loamy material showing stratification in most places. Some scattered gravel generally occur on the surface and in the silty upper layers.

The surface relief is characteristically flat or gently undulating, and the land lies well for farming operations, although some of the narrow terrace margins are not so well situated. The land is well drained, and although water does not drain freely from the nearly level surface, the internal structure allows excess moisture to escape readily. In dry seasons the soil may be a little droughty.

Probably 75 or 80 percent of this soil is improved farm land. In normal seasons good yields of the common crops—corn, oats, and hay—are produced. With suitable liming, good stands of clover and alfalfa are obtained.

Chenango silt loam, rolling phase.—A rolling phase of Chenango silt loam occurs in a few places, as about 2 miles south of Wake, where the soil has a much more uneven surface and includes knolls, depressions, and ridgy areas. The uneven surface relief makes soil of this phase less desirable for cultivation. The characteristics of this soil are about the same as those of the typical soil, with the exception that some of the steeper slopes may be gravelly, and in the depressions the surface soil may have a greater thickness over the subsoil gravel. Most of this rolling land is kept in grass for mowing or pasture and is not cultivated regularly.

Chenango gravelly loam.—Chenango gravelly loam, associated with the related Chenango silt loam, occurs in about the same topographic positions and has similar surface relief. The soil materials evidently were laid down by rather swiftly moving waters. Most of the areas occur along the Susquehanna River Valley.

The surface soil of Chenango gravelly loam is dark grayish-brown friable loam with a fairly large content of well-rounded gravel and small cobbles, mostly of sandstone, together with a few chert. Below a depth of 6 or 8 inches, the material is brownish-yellow gravelly loam which, with depth, becomes more loose and open and, at a depth ranging from 18 to 24 inches, becomes a brown loose, more or less stratified, gravelly sandy deposit. The entire soil material is acid in reaction.

Much of the soil is so loose as to be excessively drained, and in dry seasons crops do not have enough moisture, but the areas with deeper and heavier upper layers support a better plant growth. The more droughty areas, such as that 1 mile or more north of Conklin Center, are less likely to be cultivated regularly. With abundant rainfall fairly good yields of general crops are obtained.

Chenango gravelly loam, broken phase.—The broken phase of Chenango gravelly loam differs from the typical soil in that it is much more uneven and steep. It occurs on terrace margins and in uneven hummocky areas. From many of the steeper areas, more or less of the finer soil has been washed away and deposited at lower levels. The land has a low agricultural value, and nearly all of it is used for the pasture it affords or for wood lots. Some included steep areas have a calcareous subsoil and have limestone gravel near the surface. Such areas support a better growth of grasses or cultivated crops, where they can be grown.

Chenango fine sandy loam.—Chenango fine sandy loam has about the same general characteristics as Chenango silt loam. Its total area is smaller, but it is distributed about as widely, although it does not occur in large areas.

The surface soil is dull grayish-brown friable fine sandy loam containing some scattered rounded sandstone gravel. Below this layer the color becomes lighter, and, at a depth of about 18 inches, there is a loose deposit of stratified sandy gravelly material. All the soil material is acid, but in places lime-incrusted gravel occur at a depth ranging from 15 to 20 feet. In a few places, notably in the Chenango

Valley State Park, this soil has a very fine sandy loam texture, but in other respects is not essentially different from other areas of Chenango fine sandy loam. Although used for the same crops as Chenango silt loam, it is slightly less productive.

Howard gravelly loam.—Howard gravelly loam includes most of the gravelly second bottoms along Chenango and Tioughnioga Rivers and some areas in the Susquehanna River Valley at and below Binghamton. It occupies nearly level or undulating terraces irregularly distributed and differing in area from place to place.

Except that it is less acid, this soil is practically the same as Chenango gravelly loam. It has a surface soil of dark grayish-brown friable gravelly loam, most of the gravel being well-rounded fine-grained sandstone. This material grades below into brownish-yellow and light brownish-yellow sandy gravelly loam which, at a depth of 2 feet or deeper, consists of stratified or cross-bedded layers of rounded brown gravelly and sandy materials, some of which, at a depth ranging from 3 to 4 feet, are composed of limestone. The unmodified surface soil is acid in reaction, but, at a depth ranging from 20 to 24 inches, the reaction is less acid and in many places only slightly acid or neutral. The alkalinity increases with depth, and, at a depth ranging from 3 to 4 feet, it is, in general, distinctly alkaline, and in many places enough free carbonates are present to produce effervescence with acid. At this depth some limestone gravel occur in places, but for the most part they occur at a greater depth. This alkaline and calcareous condition differs considerably from place to place, the material in some places too small to outline on the map being acid to a depth of several feet, and here the soil is typical Chenango.

This soil, where the upper layers are typically loamy, produces good yields of staple crops and in places such truck crops as cabbage, spinach, lettuce, and others. The special value of this soil is its more favorable calcareous composition for alfalfa, which is a deep-rooted crop, and the somewhat more favorable condition for clovers and other crops. This is reflected in the better growth of vegetation where, according to the landowners, the soil has had no special treatment.

Howard fine sandy loam.—Howard fine sandy loam is associated with Howard gravelly loam and, although it has a smaller total area, occurs in the same parts of the county.

In texture and color this soil is practically identical with Chenango fine sandy loam, but it differs in the alkaline and calcareous composition of the subsoil layers. Under normal conditions the subsoil, at a depth ranging from 20 to 24 inches, is alkaline, and in many places a few inches below it may be sufficiently calcareous to effervesce with acid. A representative area is about 1½ miles east of Chenango Bridge. The depth and intensity of alkalinity differs considerably from place to place within short distances. As a whole, this soil is productive and is especially favorable for deep-rooted crops, such as alfalfa.

Unadilla silt loam.—Unadilla silt loam differs from the Chenango soils in having a much greater thickness of fine silty material overlying the gravel subsoil layer which in most places lies at a depth ranging from 3 to more than 4 feet. It has about the same surface features as the Chenango soils and is good productive land. The thicker

deposit of heavier soil material makes it more drought resistant and gives it an agricultural value greater than that of Chenango silt loam. Only a few areas are mapped, principally west of Endicott, at Vestal, at Langdon, and about 1 mile north of Kirkwood.

Included with this soil as mapped is a small area near Wake, which differs from the typical soil in that it has a ruddy-brown compact moderately friable alkaline silty clay subsoil, presumably deposited in quiet ponded waters, underlying a light-brown silty friable surface soil which seems to be productive.

Otisville gravelly loam.—Otisville gravelly loam is associated with the Chenango soils and includes the rougher, uneven, hummocky, and eskerlike formations, all of which occupy second-bottom positions. It occurs in a few small widely separated areas, as 1 mile south of Vallonia Springs, southwest of East Windsor, and in the vicinity of Lisle. The surface soil consists of a few inches of dull yellowish-brown gritty loam which is more or less gravelly and cobbly. This is underlain by a bed, several feet thick, of variously stratified and cross-bedded loam, sand, gravel, and stones, all well water-worn. The material to a depth of many feet has an acid reaction. Some areas in the vicinity of Center Lisle contain some lime-incrusted gravel at a depth ranging from 8 to 10 feet below the surface.

Included with mapped areas of this soil are a few bodies of soil that, in physical characteristics, closely resemble Otisville gravelly loam and have about the same agricultural value, but they differ from the Otisville soil in that they contain sufficient brown sandstone and red shale to give the material a red cast. This soil is properly associated with the Tunkhannock and Lackawanna soils and is mapped as Colchester farther east in Delaware County where it is more extensive. In Broome County it occurs in a few areas in the valley of Oquaga Creek.

Otisville gravelly loam is porous and leachy, and its droughtiness, together with its rough surface, gives the land a low agricultural value. Some of the smoother areas are cultivated at times, but probably more than 90 percent of this land is used for pasture or forestry.

SOILS OF THE FIRST BOTTOMS

The soils of the first bottoms are more or less subject to overflow during the higher stages of the streams, and at such times some additional sediments are usually deposited. Most of the soil materials have been washed from the adjacent uplands during a long period of years, and they consist largely of materials derived from sandstones and shale, which are naturally acid, and the alluvium from this source is of acid reaction. This condition applies to practically all the first bottoms in the eastern and southern parts of the county. Tioughnioga River, which has its source in a limestone area north of the county, has carried limy sediments and soluble matter from that area, as well as from the limy terraces along its valley, and deposited them in the sediments laid down by this stream along its course and along the lower course of Chenango River. Separation of these soils has been made on the basis of the acidity or the alkalinity (lime content) of the soil material.

The acid soils of the stream bottoms, showing good drainage, are classed in the Tioga series. These are brown or light-brown soils. Tioga silt loam, with a high-bottom phase and an alluvial-fan phase, and Tioga fine sandy loam are mapped. The bottoms with moderately deficient drainage are separated as Middlebury silt loam. The poorly drained, low-lying, light-colored and mottled soils in the bottom lands are classed as Holly silt loam. Very poorly drained bottom land of mixed texture and material is classed as meadow. The alkaline-reacting soils of the bottoms are brown where well drained and are classed as Chagrin silt loam and Chagrin fine sandy loam.

All the soils in the bottoms when well drained are good soils for corn, owing to their favorable supply of organic matter, in contrast to the upland soils which, where well drained, are deficient in organic matter. Oats are not so well adapted to the bottom land, as the nitrogen supplied by the organic matter results in a rank but weak growth of straw, which is inclined to lodge. Grasses, including clovers, produce excellent stands, and good pastures are maintained easily. The Chagrin soils, as a rule, support a better growth of grass and clover than do the Tioga soils.

Chagrin silt loam.—Nearly all of Chagrin silt loam occurs in a number of areas along Chenango and Tioughnioga Rivers, and it is the predominating soil in the first bottoms along these streams. One area lies south of Windsor.

The general characteristics of this soil are about the same as those of Tioga silt loam, but this soil differs from the Tioga soil in its alkaline condition at some subsoil level reached by the roots of most plants, usually within a depth of 26 inches. The 8-inch surface soil is dull-brown or grayish-brown friable crumbly silt loam. This material grades into light-brown friable silt loam or very fine sandy loam, which, with depth, becomes somewhat firmly bedded. Fine sand, loamy fine sand, or medium fine sand variations occur in most places at a depth below 2 feet. The surface soil is acid in practically all areas, but at and below a depth of 8 or 10 inches the material generally shows alkalinity. Drainage is well established at normal and low stages of the streams, but in wetter seasons the ground water level may be at a depth of 2½ or 3 feet.

This is a strong productive soil for corn and grass crops. Some of the areas more subject to overflow, as in the vicinity of Port Dickinson, are not cropped because of this hazard but are retained as permanent pasture. Grasses, such as Rhode Island bent and Kentucky bluegrass, and red and alsike clovers thrive well.

This soil in many places has small quantities of rounded sandstone gravel scattered over the surface and within the soil mass. In a few places the quantity of gravel is sufficient to modify the texture and tillage qualities of the soil. Such areas occur along Tioughnioga River.

Included with Chagrin silt loam as mapped are several small areas having deficient subsoil drainage, most of which are too small to outline on the map as Eel silt loam. Such areas, as the one north of Killawog, have a dark-brown friable silt loam surface soil which, below a depth of a few inches, becomes light brown, and at a depth ranging from 12 to 16 inches, changes to dull-gray or brownish-gray compact sticky gritty silt or gritty loam, mottled

with rust brown, bluish gray, and other variations. Ground water, except in drier seasons, rises to a rather high level in the subsoil. The material below the topmost few inches is alkaline. Deficient drainage limits the use of this land for cultivated crops, but grass for mowing or for pasture thrives well.

Chagrin fine sandy loam.—Chagrin fine sandy loam occurs in association with Chagrin silt loam and differs from that soil in the somewhat larger content of very fine sand and fine sand in the surface soil, which gives it a slightly more loamy character. This soil seems to have about the same productive value as Chagrin silt loam.

Tioga silt loam.—Tioga silt loam is developed along all the larger streams of the eastern and southern parts of the county where the overflow stream waters have flowed with moderate velocity. Most of this soil is best developed along Susquehanna River, and some areas are along Nanticoke Creek.

The surface soil, to a depth of about 8 inches, is dull light-brown friable silt loam, below which is light firmly bedded crumbly silt loam or silty loam. The material becomes more gritty or sandy at a depth of 18 or 20 inches, and at a depth ranging from 24 to 30 inches, is light-brown gritty loam or very fine sandy loam. In many places small quantities of rounded sandstone gravel are scattered over the surface or embedded in the soil. The soil material to a depth ranging from 3 to 4 feet is acid in reaction.

Good surface drainage prevails, but at a depth of 3 feet or deeper the soil may be saturated in wet seasons or during high stages of the streams. The surface relief is nearly level or very slightly sloping, with depressions in places marking old channels.

Included with mapped areas of Tioga silt loam are a few small bodies southeast of Deposit along West Branch Delaware River, in which the soil differs from the Tioga soil in being composed of red sandstone and shale materials which give it a characteristic Indian-red color. Here the surface soil is ruddy-brown or dark brownish-red friable crumbly silt loam. Below the cultivated surface layer is bright ruddy-brown or brownish-red firm friable silt loam which, at a depth ranging from 30 to 40 inches, in most places becomes more loose because of layers of sand or fine gravel or variously bedded deposits of these materials. The entire soil is acid in reaction, and it is all well drained. The somewhat darker color indicates a fair quantity of accumulated organic matter which contributes to the generally good productiveness of this soil.

The gravelly areas of Tioga silt loam occur in the first bottoms along most of the smaller streams, where the soil consists largely of materials deposited by comparatively swift flowing water. In the narrow valleys where most of this soil occurs, the more or less tortuous channels have caused deposition of materials of very variable character; hence the soil has no very constant textural uniformity but ranges from gravelly and sandy to loamy. Most of this land is fairly well drained, but many old channels and depressions are more or less wet, and the soil here approximates a meadow condition. The average soil consists of dull grayish-brown gritty friable loam containing various quantities of angular or slightly rounded sandstone gravel and small platy stones. This is underlain by more or less gravelly

lighter brown gritty loam, with the coarser materials more plentiful at the lower depths.

Some of the smoother areas are cultivated, but the cultivated land does not total more than 10 or 15 percent of the mapped areas. The cultivated land is productive, especially for corn and hay. Most of the narrower bottoms, having rougher surfaces and more subject to overflows, are kept in permanent pasture, as pasture grasses thrive and running water is available. Much of the land is clear of trees but supports a rather heavy brushy growth, and in places it supports a fairly heavy stand of elm, beech, poplar, willow, and other trees.

Tioga silt loam, high-bottom phase.—Tioga silt loam, high-bottom phase, is essentially the same as the low-lying typical soil, but it lies several feet above the overflow level of the streams. Most of this land has sufficient slope to facilitate easy run-off of surface waters and is somewhat more completely drained than the typical soil and, therefore, is desirable farm land. Owing to its high position, this soil is farmed in the same manner as other soils on the terraces, particularly Unadilla silt loam and Chenango silt loam. By the addition of soil amendments the yields of staple crops are equal to those obtained on typical Tioga silt loam.

Tioga silt loam, alluvial-fan phase.—Tioga silt loam, alluvial-fan phase, occurs in many small triangular-shaped bodies along all the larger valley bottoms at the mouths of the smaller tributary stream valleys, where overflow waters have spread outwash materials in the larger valleys. These formations occur at somewhat higher levels than do the main valley bottoms and to some extent occupy terracelike positions. The slope is toward the main stream. The land is well drained and in general is not subject to overflow, as this tendency has been lessened by deepening and straightening the stream channels.

The cultivated surface soil consists of light grayish-brown friable silt loam or silty loam, containing liberal quantities of somewhat rounded sandstone gravel and small stones. This layer is underlain by lighter brown firmly bedded loamy material, in which the gravel and small stone content is, in most places, more plentiful at a depth of 2 feet or deeper.

Probably more than 90 percent of this land is improved, and it is regarded as desirable farm land. Good yields of corn, hay, and forage crops are obtained. The land is smooth and, as it is traversed in many places by highways, provides desirable sites for farm buildings.

Tioga fine sandy loam.—Tioga fine sandy loam is associated with Tioga silt loam and includes scattered areas, most of which are adjacent to the main stream, where overflow waters have been comparatively swift.

The surface soil is mellow light-brown fine sandy loam or loamy fine sand, which grades into yellowish-brown or lighter colored fine sandy loam. At a depth of 2½ or 3 feet, this material is underlain by loamy fine sand or sandy material that is noticeably looser than the surface soil. Drainage is good, and the land is smooth. This soil is easy to cultivate and has about the same productive value as Tioga silt loam.

Middlebury silt loam.—Middlebury silt loam is associated with the Tioga soils in positions where drainage is but moderately well established. This soil occurs toward the outer borders of the first bottoms, where underdrainage is sluggish. Areas lie just north of Maine, 2 miles northwest of Johnson City, and 2 miles southeast of the State hospital. Numerous smaller bodies are included with Tioga silt loam because of their small extent or the difficulty of outlining them on the map.

The surface soil of Middlebury silt loam consists of light-brown or slightly grayish brown friable silt loam. This is underlain by rather compact dull-gray gritty silt loam or loam mottled with rust brown, yellow, and darker variations. At a depth ranging from 24 to 31 inches the material in most places becomes more sandy, gravelly, looser, and browner, and the mottlings are less noticeable. All the soil material is acid, but in places, at a depth of about 36 inches, the reaction appears less acid.

Most of this land is improved and produces satisfactory yields of the general farm crops.

Holly silt loam.—Holly silt loam is associated with Tioga silt loam and occupies somewhat lower lying positions, generally along the outer bottom margins, where drainage is very poor. A number of widely distributed areas occur in the wider stream bottoms.

Most of the soil material is gray, or lighter colored than the Tioga soils, although the surface layer in many places is dark and mucky from the accumulation of organic matter. The material is wet much of the time, has more or less mottling from the surface downward, and has a dense, more or less plastic, and compact subsoil. This soil is very variable, but in general it consists of dark grayish-brown moderately friable silt loam faintly mottled with brown, rust brown, and darker colors. Below a depth of 5 or 6 inches the material is lighter brown or bluish-gray highly mottled silt loam which, below a depth of 18 or 20 inches, changes to compact impervious sticky silty clay, with gray and brown mottlings predominating.

Very little of this land is cultivated. Most of it is utilized for pasture, and sometimes the grasses from a part of it are mowed for such coarse hay as it commonly produces.

Meadow.—Meadow includes poorly drained first-bottom land of such variable character that no type designation could be given it. Much of it is swampy and may be covered with water for long periods. Most of the areas mapped are small, scattered, and represent a soil condition rather than a definite soil. In places small deposits of muck or peat occur. Most of this land is covered with forest or a brushy growth, but some is sufficiently cleared to furnish some pasture.

Peat.—Peat consists of accumulations of various kinds of organic matter composed of both woody and grassy constituents, which occupy depressions in a number of locations on the uplands and in the valley bottoms. Evidently many of these areas were once small lakes or ponds, which, in the course of time, have become filled with plant remains. Some of the material seems to be derived from grasses, sedges, and mosses, whereas other areas are largely woody, and in many places fairly large mature trees grow on the peat areas. Most of the areas are not more than 50 acres in extent.

Peat consists of coarsely granular material derived from the woody or coarse grassy vegetation, probably most of it being composed of woody material. Downward from the surface the material contains considerable quantities of tree branches, twigs, shrubs, and larger spongy woody fragments, interlaced and bedded with finer material. Some deposits are many feet thick. Some of the shallower areas are better drained for a part of the year, and the material is well decomposed to a mucky consistence.

No use is made of these peat areas, and nearly all of them support a tree or brush cover. Pine, hemlock, elm, soft maple, willow, and other trees and shrubs are common.

ROUGH STONY LAND

Rough stony land includes those areas of steep land that cannot be used for ordinary agricultural purposes. It occurs as strips or belts, including the steep valley sides which in many places rise to a height ranging from 200 to more than 300 feet. Rock outcrops are common, and detached blocks of rock occur in many places. The soil mantle is shallow and variable at the upper levels, but the lower slopes may have deeper accumulations from hillside creep. Nearly all this land is forested with several varieties of native trees, and these constitute its chief value. More or less cleared areas favorably located provide fairly good pasture.

SOILS AND THEIR INTERPRETATION

Broome County forms a part of the Allegheny Plateau uplift of southern New York. It lies west of the more rugged Catskill Mountain section, but the land is well dissected, and elevations range from about 800 feet as a minimum valley level to ridge elevations of as much as 1,600 feet, with a few higher elevations.

The soils have been developed, through the influence of vegetation and climate, mainly from glacial materials. On the higher elevations, the soil mantle in most places is thin, but it is thicker in the lower lying valleys where opportunity has been afforded for more extensive deposition.

Soil development has progressed under forested conditions in a humid climate, and the soils are designated as Gray-Brown Podzolic soils. As they have developed under a forest cover, the soils are comparatively light in color, and the leaching process that has been going on for centuries has removed to greater or less depths most of the original lime content that may have been present.

The well-drained soils contain a small quantity of organic matter, but most of the soils having poor or deficient drainage contain larger amounts and the color is darker. Where poor drainage has prevailed, leaching and oxidation have been retarded to the extent that retention of organic matter has been favored. The Lordstown and Wooster soils are representative of the well-drained soils, and the poorly drained soils having a higher organic-matter content are represented by the Volusia and Chippewa. The Lordstown soils are shallow over bedrock, and the Wooster soils are deeply bedded but friable and have free surface and internal drainage.

The present vegetation is predominantly deciduous trees including several species of oak, sugar maple, poplar, elm, and beech, but a considerable proportion of the virgin timber was white pine, with some hemlock. At present these conifers are few and scattered.

The parent material of the soils of the upland is predominantly glacial drift which consists principally of gray sandstone and shale debris. Although this material has been ground by glacial action, some of it has been moved only a short distance. It underlies the larger part of the county. The small area in the southeastern part is underlain by coarser grained brown sandstone and red shales which impart a more or less red color and a more gritty texture to the glacial drift and the soils derived from it. The siliceous materials from the underlying rocks are responsible, in part, for the prevailingly acid character of the soils.

The valley-fill material, composing the valley terraces, also is largely of sandstone and shale origin, but in places it has a noticeable content of limestone gravel which has been carried by the glaciers from limestone beds farther north. In many places the content of limestone is sufficient to influence vegetal growth favorably.

Of the upland soils, the Lordstown and Bath occupy the main ridge tops and many of the higher elevations. These grade down the slopes into the Canfield, Langford, Volusia, and Chippewa soils, interspersed here and there by areas of the better oxidized Wooster soils. The Canfield, Langford, Volusia, and Chippewa soils have indurated or hardpan subsoils, induced by excess water as seepage from higher levels. In the Canfield and Langford soils the indurated layers occur at greater depths than in the Volusia and Chippewa soils. The Volusia soils are imperfectly drained, and the Chippewa soils are poorly drained. The Culvers soils, and to some extent the Walton soils, are comparable to the Canfield soils in position and character of the subsoil layers. At lower elevations on the valley floors are the Chenango soils occupying the terrace positions, and the Tioga, Chagrin, Middlebury, and Holly soils occupying the lower flood plain levels.

The Lordstown, Bath, and Wooster soils represent the best developed, most nearly normal soils in the county. The soils having indurated subsoil layers are considered imperfectly developed and are not deeply oxidized. The Chenango soils, having comparatively open structures, are more thoroughly drained and more deeply oxidized.

The soil profile considered most nearly normal consists, in general, of a thin dark-colored surface mantle grading into dull yellowish-brown friable material a few inches thick, becoming dull brown below. At a depth of 12 or 14 inches, the material is light brown and may be compact, but it does not have a hardpan structure. This condition is represented by a profile of Wooster silt loam, as observed at the Vestal Hills golf course, which shows the following layers:

A_1. 0 to ½ inch, dark-colored turf consisting of matted roots and decayed vegetable matter.

A_2. ½ to 8 inches, light-brown, yellowish-brown, or brown friable silt loam containing some angular or rounded pebbles.

A_{21}. 8 to 14 inches, dull-brown friable silt loam.

B_2. 14 to 18 inches, light brownish-yellow friable silt loam having some darker streaks infiltrated from the layer above.

B_3. 18 to 40 inches, dull brownish-yellow friable silt loam containing a few angular sandstone and rounded gravel.

C. 40 to 60 inches, a thin layer of compact gritty loam suggesting mild induration, splotched or streaked with brown, light brown, and a little gray, and having a small sandstone content, underlain by a thicker layer of bright-brown silt loam which is compact but brittle and easily crushed in the fingers. The color is modified with some lines and spots of brown and dark brown. The material is somewhat vesicular.

All layers show a distinct acid reaction by the LaMotte test.

In comparison with the above description, the following description of a shallower profile, that of Lordstown gravelly silt loam, as observed 2½ miles northwest of Johnson City, at an elevation of 1,350 feet, is given.

A_1. 0 to 3 inches, dark yellowish-brown friable silt loam, with darker streaks or lobes, extending into the yellow material below. The topmost part is permeated with grass roots.

A_2. 3 to 9 inches, pale brownish-yellow friable silt loam which grades imperceptibly into the layer below.

B_2. 9 to 26 inches, brownish-yellow friable silt loam.

C. 26 to 30 inches, compact slightly indurated silt loam which breaks up fairly readily into small aggregates. The color is brownish yellow, with some faint-brown mottlings. This layer rests on fine-grained shaly sandstone.

Throughout the profile is a moderate content of small flat and angular sandstones and gravel. The material in all layers is decidedly acid, according to the LaMotte test.

Among the soils derived largely from brown or reddish-brown sandstones and shales is Lackawanna silt loam. A description of a profile of a rather shallow, approximately virgin, area of this soil, lying at an elevation of about 1,680 feet, one-half mile southeast of Hawleyton, follows:

A_1. 0 to 5 inches, dark ruddy-brown friable silt loam with a moderate content of brown sandstone and shale chips and angular gravel.

A_2. 5 to 9 inches, brownish-red friable silt loam with a liberal content of fine red shale chips and angular gravel.

B_2. 9 to 19 inches, dull-red or Indian-red shaly silt loam containing some angular gravel.

C. 19 to 28 inches, a compact duller mixture of red shale and decomposed silty material, in an almost hardpan condition, from the partly decomposed shale and sandstone which directly underlie this layer.

The material in all layers is distinctly acid.

The Walton soils are of small extent, have less red color than those occurring in Delaware County, but they occupy similar low valley-fill positions. Their profile development is similar to that of the Lackawanna soils, but they have developed from slightly heavier and deeper till derived from the same material as the Lackawanna soils—reddish-brown sandstone.

The Chenango soils developed on the terraces have the common characteristics of these soils—light color, gravelly substratum, good drainage, and acid reaction to a depth of several feet.

In many locations, chiefly along Chenango and Tioughnioga Rivers, the soil on the terraces has limestone gravel or other limy materials within a depth of 3 feet, in sufficient quantity to favorably influence vegetation. Otherwise this soil, designated as Howard gravelly loam, appears about the same as the Chenango soils.

The group of soils having indurated or hardpan subsoils caused principally by excess soil moisture, fed by seepage and in places by slightly retarded run-off, is represented by Volusia silt loam. This is an extensive and well-distributed soil. The description of

a profile of Volusia silt loam, as observed 3 miles northwest of Johnson City, follows:

A_1. 0 to 7 inches, brown or grayish-brown mellow silt loam containing scattered small sandstone and angular gravel. The vegetal cover is poverty grass and mossy plants.
A_2. 7 to 10 inches, dull pale-yellow friable silt loam.
A_3. 10 to 18 inches, orange-yellow friable silt loam streaked and mottled with bluish gray.
B_2. 18 to 26 inches, light bluish-gray silt loam mottled with yellowish brown, black, and brown. The structure is that of a compact hardpan, but the material breaks readily into irregular angular fragments. The bluish-gray material, when moist, has a soapy slick feel.
C. 26 to 50 inches, very dense but brittle silty clay of a general yellowish-brown color mottled with yellow, brown, bluish gray, and dark brown.

Some angular sandstones and gravel are distributed through the layers. The material in all layers is decidedly acid, according to the LaMotte test.

The Canfield soils, as well as the Langford, differ from the Volusia in having much more deeply oxidized layers overlying the hardpan subsoil layer. The Chippewa soils have much poorer drainage than the Volusia, and their prevailingly wet and saturated condition prevents any important soil development.

The Langford soils differ from the Canfield in having subsoil materials of alkaline reaction. A description of a profile of Langford gravelly silt loam follows:

A_1. 0 to 3 inches, grayish-brown friable silt loam having a ½-inch mantle of dark-brown leaf mold. The material in this layer is acid in reaction.
A_2. 3 to 9 inches, brownish-yellow friable silt loam which is acid in reaction.
A_3. 9 to 20 inches, yellow or slightly brownish yellow friable or moderately friable silt loam which, in the lower part, becomes slightly mottled with rust yellow. This material is slightly acid.
B_2. 20 to 35 inches, gray and rust-yellow silty clay of hardpan structure which is slightly vesicular and is alkaline in reaction.
C. 35 to 55 inches, brownish-yellow and gray silty clay hardpan. The gray mottling is not so noticeable as in the overlying layer but has a more dull brown cast. The material is alkaline in reaction.

More or less platy small gray sandstones and angular gravel are on the surface and distributed through the solum.

The Culvers soils are very similar to the Canfield. They have developed hardpan subsoils which have induced poor drainage. They are derived from a mixture of red and gray materials.

The Chagrin, Tioga, Middlebury, and Holly soils and meadow are alluvial soils occupying the present flood plain. These soils are young and have suffered little or no leaching, therefore have no developed profile. Both the Chagrin and Tioga are well drained. They differ in that the Tioga soils are acid through the entire solum, whereas the Chagrin soils show an alkaline reaction within a depth of 3 feet.

The Middlebury soils differ from the Tioga soils in having lighter colored subsoils, generally mottled, owing to deficient drainage. The Holly soils occur in the smooth poorly drained first bottoms and are in general lighter colored than the Tioga soils. Meadow includes a complex of overflow bottom land having different textures, drainage, and surface character.

CLASSIFICATION OF SOIL TYPES ACCORDING TO PRODUCTIVITY

Table 6 gives a classification of the soil types, according to productivity, for each of the important crops grown in Broome County.

TABLE 6.—*Classification of soil types in Broome County, N. Y., according*

Soil type	Productivity rating according to—		Crop product					
	Inherent productivity [1]	Current practices [2]	Corn silage	Oats	Buckwheat	Tame-grass hay [4]	Legu-minous hay	Alfal
	Grade no.	*Grade no.*						
Tioga silt loam, high-bottom phase	1	1	70(90)	60(80)	50	80	50(70)	40(
Unadilla silt loam	2	2	60(80)	50(80)	50	70	50(70)	40(
Tioga silt loam, alluvial-fan phase			60(80)	50(70)	50	80	40(60)	40(
Chagrin silt loam	[8] 1	2	90	70	50	90	70	50
	[9] 3	4	70	50	40	80	50	20
Chagrin fine sandy loam	[8] 1	3	80	60	50	80	60	50
	[9] 3	5	60	40	40	70	40	20
Tioga silt loam	[8] 1	3	90	70	50	90	60	40
	[9] 3	4	70	50	40	80	40	20
Tioga fine sandy loam	[8] 1	3	80	60	50	80	50	40
	[9] 3	5	60	40	40	70	30	20
Howard gravelly loam	3	3	50(70)	50(70)	50	40(60)	40(70)	40(
Howard fine sandy loam		3	50(70)	50(70)	50	40(60)	40(70)	40(
Walton silt loam		3	50(70)	50(70)	70	70	40(70)	30(
Wooster silt loam		3	50(70)	50(70)	70	60	40(60)	30(
Wooster gravelly loam		4	40(60)	50(70)	60	50	40(60)	30(
Chenango silt loam		3	50(70)	50(70)	50	40(60)	40(60)	40(
Bath silt loam		3	40(60)	50(70)	70	60	40(60)	20(
Chenango gravelly loam	4	4	40(60)	30(50)	40	30(50)	40(50)	40(
Chenango fine sandy loam			40(60)	30(50)	40	30(50)	30(50)	30(
Langford gravelly silt loam			30(60)	50(70)	70	60	40(60)	20(

[1] Soil types having the highest general productivity in the county are rated grade 1. When 2 inherent productivity ratings ber when the land is drained, or protected from flood, and the lower figure refers to the grade number when the land is undrain

[2] The grade number in this column gives the comparative productivity, according to current farm practices of management

[3] Soil types inherently most productive for the specified crop in the United States=100. Only those inherently most produ the standard. Unusually productive soils of limited acreage rate above 100. Figures in parentheses indicate the productivity include the use of soil amendments as lime, fertilizers, and manure.

[4] In the case of items, such as tame-grass hay, leguminous hay, vegetables, small fruits, melons, and tree fruits, which includ productivity of the soil type for that member of the group best adapted to the soil type in question. Thus, soil types well ada for tree fruits, although their adaptability to peaches or other fruits may be poor. In Broome County timothy and red clover we grass hay and leguminous hay, respectively. Apples were used for tree fruits.

[5] Vegetables doing best on highly organic soils; e. g., onions, celery, lettuce.

[6] Vegetables not requiring highly organic soils.

[7] Only a general comparative rating for forest for the county is given. Order of preference is A, B, C.

[8] Drained land with optimum protection from overflow.

[9] Undrained land with no protection from overflow.

TABLE 6.—*Classification of soil types in Broome County, N. Y., according to pr*

Soil type	Productivity rating according to—		Crop produc					
	Inherent productivity	Current practices	Corn silage	Oats	Buckwheat	Tamegrass hay	Leguminous hay	Alfa
	Grade no.	*Grade no.*						
Canfield gravelly silt loam	5	4	30(50)	50(70)	70	50	30(50)	10
Canfield silt loam		4	30(50)	50(70)	70	50	30(50)	10
Chenango silt loam, rolling phase		4	30(50)	30(50)	30	30(50)	30(50)	30
Culvers gravelly silt loam		5	30(50)	40(60)	60	50	20(40)	10
Middlebury silt loam	[8] 4	5	70	50	50	80	50	
	[9] 6	7	30	30	30	60	30	
Lackawanna silt loam	6	5	30(60)	40(60)	50(70)	40	30(50)	
Canfield gravelly silt loam, shallow phase		5	30(50)	40(60)	40	40	20(40)	
Lordstown gravelly silt loam		5	30(60)	40(60)	40(70)	30	20(40)	
Fremont silt loam		6	30(50)	30(50)	50	50	20(40)	
Canfield gravelly silt loam, steep phase [10]	7	7	20	30	40	30	10	
Wooster gravelly loam, steep phase [10]			20	20	20	20	10	10
Otisville gravelly loam [11]			30	20	20	20	10	10
Volusia silt loam			20(40)	30(50)	40(50)	40	10(20)	
Lackawanna stony silt loam			20(50)	30(50)	30(50)	20	10(30)	
Lordstown stony silt loam			20(50)	30(50)	30(50)	20	10(30)	
Holly silt loam	[8] 5	6	50	50	40	70	40	
	[9] 10	9				10		
Volusia silt loam, steep phase [10]	8	8	10	10	10	20		
Lordstown gravelly silt loam, steep phase [10]			10	10	10	10		
Lordstown stony silt loam, steep phase [10]		9	10	10	10	10		
Chippewa silt loam, undrained	9	9						
Chenango gravelly loam, broken phase [10]		9				20		
Meadow, undrained		9				20		
Peat, undrained		10						
Rough stony land	10	10						

[8] Drained land with optimum protection from overflow.
[9] Undrained land with no protection from overflow.
[10] Steep or stony land, on which tillage is extremely difficult.
[11] Moderately hilly or stony land, not very erosive, but not well adapted to farm machinery.

This classification compares the inherent productivity of each of the soil types in the county for a given crop, to a standard, namely the soil type (or types) with a significant acreage inherently most productive in the United States for that crop. The most productive soil type in the United States for a given crop is given a productivity index of 100 for that crop, which is called the base index and is the standard with which the productivity of all other soil types for that crop is compared. Therefore, a soil type estimated to be about half as productive for that crop as the best in the United States receives an index of 50. In a few instances unusually productive soils of limited acreage will carry, necessarily, an index above 100 for a specified crop. The inherent productivity indexes are based on the ability of the land to produce under a management capable of maintaining the inherent or natural level of productivity.

In addition to productivity indexes for each important crop, each soil type is assigned a general productivity rating, or grading, of agricultural quality. The soil types having the highest average productivity indexes in the county are given the rating, or grade, of 1 for that county, the soil types having the next highest the grade of 2, and so on. The soil types falling in the same grade are listed in the table in the order of highest average inherent productivity indexes.

In the determination of this general productivity grade, more weight is given to productivity of the important staple crops than of minor crops. These values indicate, as nearly as possible, the inherent or natural productive capacity of the soil types, regardless of such important considerations as differences due to previous management and the accessibility of markets.

Obviously the inherent or natural productive capacity of land means the productivity without the repeated use of amendments. Yields obtained through the use of amendments, as lime, water, and fertilizer, do not indicate well the inherent productivity. However, some soil types, although low in inherent productivity, are responsive to the application of amendments and produce good yields or high quality of product. Because the index of inherent productivity does not express the responsiveness of soil types to fertilizer, a second index is used (in parentheses) to compare the productive capacity of a given soil type under the amendment practices where it occurs with the inherently most productive soil type in the United States for that crop. Thus the same standard of reference is used as for the inherent crop-productivity index. This second index (in parentheses) compares what may be expected in the way of yield and quality of product from different soil types under current practices of culture. Quality of product average being equal, it would be approximately the same as a comparison of average yield of product. This index is used only where amendments are added to the land as a common practice.

A second general productivity rating is assigned in column 3 to the soil types, to indicate their relative productivity in the county under current practices of management. This rating is determined in the same general manner as the productivity rating for inherent productivity. In the case of those soil types which are not amended under practices of current management, the inherent productivity rating is the basis of the productivity rating according to current practices.

The physical factors influencing the productivity of land are mainly those of climate, soil, and surface configuration. All are considered in the determination of the productivity indexes, and a low index for a particular crop may as likely be due to an unfavorable climate or surface configuration as to fertility of soil. Surface configuration is important mainly on account of its influence on the amount of water which penetrates the soil and, with some soils, on erosion. It is of course also a secondary factor that helps to determine the character of both climate and soil.

In the case of soil types with poor natural drainage, two series of indexes are given, one applying to the soil types with no artificial drainage, the other to soil types to which optimum artificial drainage has been applied. In many instances some artificial drainage, but not the optimum, has been applied to poorly drained lands so that their inherent productivity under optimum drainage is not realized.

In the case of bottom land subject to periodic overflow, two sets of indexes are given, one applying to the land when it receives optimum protection from overflow, the other to the land with no such protection. This double series of indexes is used to indicate the potential inherent productivity in addition to the present inherent productivity of poorly drained or overflow land.

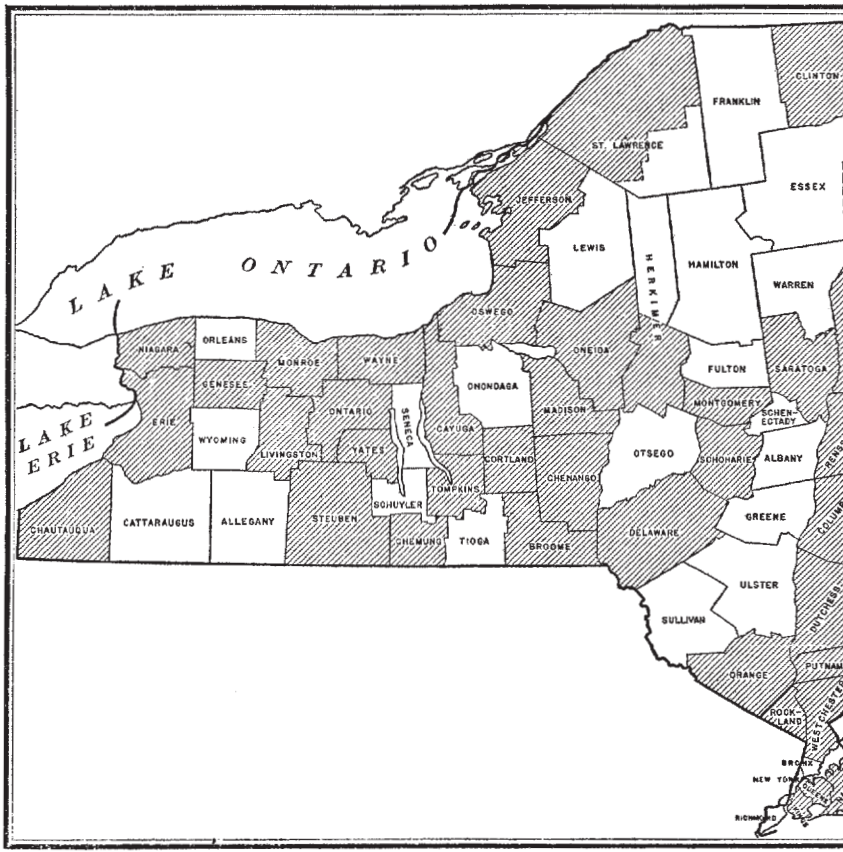
The cost or difficulty of effecting drainage or protection from overflow plays no part in the potential inherent productivity rating of such lands. Two kinds of soil having the same productivity when drained are rated the same, although optimum artificial drainage may cost 10 times as much on one as on the other.

It must be stated clearly that this classification is not to be interpreted directly into specific land values. The intention is to confine attention to essentially permanent factors of inherent productivity and not to include transitory economic considerations. In some instances the information on which to base the ratings is not so complete as desired; in these cases further study may suggest changes.

U. S. GOVERNMENT PRINTING OFFICE: 1936

Authority for printing soil survey reports in this form is carried in the Appropriation Act for the Department of Agriculture for the fiscal year ending June 30, 1933 (47 U. S. Stat., p. 612), as follows:

There shall be printed, as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it, a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than two hundred and fifty copies shall be for the use of each Senator from the State and not more than one thousand copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.



Areas surveyed in New York shown by shading. Detailed surveys shown by north

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To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

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U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
HENRY G. KNIGHT, CHIEF
CHARLES E. KELLOGG, IN CHARGE SOIL SURVEY

SOIL MAP
BROOME COUNTY
NEW YORK

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION
C. E. LADD, DIRECTOR
T. L. LYON, HEAD, DEPARTMENT OF AGRONOMY

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

City or Village, Roads, Buildings, Wharves, Levee, Breakwater, Lighthouse, Fort
Secondary roads and Trails
Railroads, Steam and Electric
Bridge, Ferry
R.R. crossings, Tunnel
Ford, Dam
School or Church, Cemetery
Mine or Quarry, Mine dumps, Made land
Bluff, Escarpment, Rock outcrop and Triangulation station
Stony and Gravelly areas
Soil boundaries
Boundary lines
Boundary lines
Boundary lines
U.S. township and section lines

RELIEF
(Printed in brown or black)

Contours, Depression contours
Prominent Hills, Mountain Peaks
Sand, Wash, and Sand dunes
Shore and Lee-wash line, Sand bar

DRAINAGE
(Printed in blue)

Streams
Lakes, Ponds, Intermittent lakes
Intermittent streams
Springs, Canals and Ditches, Flumes
Swamp, Salt marshes
Submerged marsh, Tidal flats

The above signs are in current use on the soil maps. Variations from this list are shown on the maps of earlier dates.

LEGEND

Bath silt loam — Bm	Chenango silt loam — Cs	Langford gravelly silt loam — Ld	Tioga fine sandy loam — Tf
Canfield gravelly silt loam — Cd	Cs, Rolling phase	Lordstown stony silt loam — Ll	Unadilla silt loam — Un
Cd, Steep phase	Chippewa silt loam — Ch	Ll, Steep phase	Volusia silt loam — Vl
Cd, Shallow phase	Culvers gravelly silt loam — Cy	Lordstown gravelly silt loam — Lo	Vl, Steep phase
Canfield silt loam — Ca	Fremont silt loam — Fl	Lo, Steep phase	Walton silt loam — Wa
Chagrin fine sandy loam — Cf	Holly silt loam — Hl	Middlebury silt loam — Ml	Wooster silt loam — Wl
Chagrin silt loam — Cn	Howard fine sandy loam — Hf	Otisville gravelly loam — Og	Wooster gravelly loam — Wo
Chenango fine sandy loam — C	Howard gravelly loam — Hg	Tioga silt loam — Ts	Wo, Steep phase
Chenango gravelly loam — Cg	Lackawanna stony silt loam — Lm	Ts, Alluvial-fan phase	Meadow — M
Cg, Broken phase	Lackawanna silt loam — Lw	Ts, High-bottom phase	Peat — P
		Rough stony land — Rs	Gravel pits

W. J. Latimer, Acting Inspector, District 1.
Soils surveyed by Clarence Lounsbury, in charge, and A. H. Hasty, U. S. Department of Agriculture and D. F. Kinsman and J. H. Baran, Cornell University Agricultural Experiment Station.

BASE MAP IN PART FROM
U. S. GEOLOGICAL SURVEY SHEETS

Scale 31680
3 0 2 3 4 5 Miles
1 0 1 2 3 4 5 Kilometers
Contour interval 20 feet.
Datum is mean sea level.

Field Operations
Bureau of Chemistry and Soils
1932